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The Engineer

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PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for the SUPPLY of:—
1. A 30in. SELF-PROPELLING SUCTION DREDGER, minimum discharge 1500 cubic yards per hour, and FLOATING PIPE LINE of 4500ft.
2. TWIN SCREW TUG, 80ft., to operate with above.
3. 12 SETS of DREDGER MOORINGS.
Tender forms will be obtainable on the 27th October, 1924, at the above address. 7299

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES:—
OIL TANK WAGONS.
Tenders due on the 13th November, 1924.
Tender forms obtainable from above. 7298

Civil Engineer Required FOR GOVERNMENT DEPARTMENT IN CONNECTION WITH AIRSHIP SHED AND MOORING MAST AT CARDINGTON.
Candidates must have served in H.M. Forces during the war, should preferably be associate members of the Institution of Civil Engineers, and have had good training and experience in connection with large steel structures. The salary offered will be from £500 to £685 a year, inclusive of Civil Service bonus, according to qualifications.
Written applications, with full details of experience, qualifications, age, and salary required, should be addressed to the JOINT SUBSTITUTION BOARD, Montagu House, Whitehall, S.W. 1. 7277

Executive Engineer Required by the GOVERNMENT of SIERRA LEONE in the PUBLIC WORKS DEPARTMENT, for two tours of not less than 12 nor more than 18 months' continuous residential service. Salary £600 a year. Free quarters and passages and liberal leave on full salary. Candidates, aged 28-35 should have served articles with a member of the Royal Institute of British Architects and have passed the examination qualifying for associate membership of that Institute, or possess the diploma of some recognised college which is accepted by that Institute as exempting candidates from taking the examination of the Institute. Must be a first-class draughtsman, capable of designing and carrying out buildings, taking out quantities, preparing details and specifications, and must be competent to execute building surveys, set out buildings and lay out roads. Other qualifications being equal, preference will be given to candidates who have had experience of the work of a civil engineer in the construction and carrying out of recent public works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/13,190. 7300

Royal Aircraft Establishment.—A VACANCY exists for a RESEARCH ASSISTANT in work relating to aero-engines. Candidates must have a University Honours Degree in Science or Engineering, or its equivalent, and must have had subsequent experience in engineering works. Age should not exceed thirty years. Commencing salary £250 a year plus Civil Service bonus (giving present total of £300), on scale £250-20-£350, plus bonus.—Full particulars, with copies of references, should be sent quoting Reference No. 37, stating age, experience, &c., to the SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 7276

Test Assistant, With technical training to the standard of B.Sc. Degree and works and drawing-office experience, REQUIRED at the Royal Aircraft Establishment, in connection with checking by calculation the strength and aerodynamic characteristics of aeroplanes. Starting salary 60s. per week plus Civil Service bonus, giving present total of 94s 11d. p.w. Ex-Service man preferred.—Apply, quoting A.38, to SUPERINTENDENT, R.A.E., South Farnborough, Hants. 7275

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
Notice is Hereby Given that AMERICAN CHAIN COMPANY, Incorporated, a Corporation organised under the Laws of the State of New York, one of the United States of America, of Bridgeport, State of Connecticut, United States of America, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 206,103 granted to them for "Improvements in or relating to Cable-making Machines."
Particulars of the proposed amendment were set forth in the Illustrated Official Journal (Patents), issued on the 15th October, 1924.
Any person, or persons, may give notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. TEMPLE FRANKS,
Comptroller-General.
7253

Newcastle-upon-Tyne Education COMMITTEE.
RUTHERFORD TECHNICAL COLLEGE.
Principal: C. L. ECLAIR-HEATH, Wh.Sc., A.M.I.M.E.
REQUIRED, for JANUARY NEXT, LECTURER in ELECTRICAL ENGINEERING for senior work. Candidates should have had good drawing-office and works experience, have received a good technical education in a University or Technical College, and have obtained a University Degree or its equivalent. Teaching experience desirable.
Salary according to Burnham Technical Scale, less 5 per cent.
Applications (on forms to be obtained by sending stamped addressed foolscap envelope) to be returned to the undersigned not later than first post Tuesday, 11th November, 1924.
THOS. WALLING
Director of Education.
Education Office, Northumberland-road. 7225

The Junior Institution of ENGINEERS.
SHEFFIELD AND DISTRICT SECTION.
ANNUAL GENERAL MEETING AND PRESIDENTIAL ADDRESS
by Professor J. HUSBAND, F.R.C.Sc.I., M.I.C.E., &c., "ARCHITECTURE IN ENGINEERING."
FRIDAY, 31st OCTOBER, 7.30 p.m.,
In the Rooms of the Sheffield Metallurgical Association, 196, West-street, Sheffield 7251

Bombay, Baroda, and Central INDIA RAILWAY COMPANY.
The Directors are prepared to receive up to Noon on Friday, 7th November, TENDERS for the SUPPLY of:—
WHEELS AND AXLES FOR WAGONS.
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).
The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S. YOUNG,
Secretary.
Offices: 91, Petty France, Westminster, S.W. 1.
22nd October, 1924. 7292

County Borough of Croydon. TRAMWAYS DEPARTMENT.
TO MANUFACTURERS OF ELECTRIC TRAMCAR BODIES, TRUCKS, ELECTRICAL EQUIPMENTS, &c.
NOTICE IS HEREBY GIVEN that the Council are prepared to receive TENDERS for the MANUFACTURE, SUPPLY, DELIVERY and MAINTENANCE of:—
(A) 30 COMPLETE BODIES for ELECTRIC TRAMCARS.
(B) 30 COMPLETE SETS of MAXIMUM TRACTION BOGIE TRUCKS for ELECTRIC TRAMCARS.
(C) MAGNETIC TRACK and WHEEL BRAKE EQUIPMENTS for 30 ELECTRIC TRAMCARS, and
(D) 30 COMPLETE SETS of ELECTRICAL EQUIPMENTS for TRAMCARS, together with the Assembly of 30 Car Bodies, Sets of Trucks, Electrical Equipments and Brakes, into complete Tramcars in readiness for service operation.
Specifications, forms of Tender and other particulars may be obtained on application to the Tramways Manager, Tramways Offices, Thornton Heath Surrey, on and after the 25th day of October, 1924, upon payment of a fee of £2 for either (A), (B), (C), or (D). The fee will be returned to the tenderer, provided he shall have sent in a bona fide Tender and shall not have withdrawn the same.
Particulars of the work may be obtained on application at the Tramways Offices previously to the payment of fees for the specifications, &c.
All drawings referred to in the specifications may be inspected at the above-named address on weekdays between the hours of 10 a.m. and 12 noon and 2 p.m. and 4 p.m. (Saturdays excepted) on production of a copy of the specification concerned or an official receipt for the fee paid therefor.
Tenders on the prescribed form to be sent to me by Ten o'clock in the forenoon of Saturday, the 22nd day of November, 1924.
Tenders will only be received subject to the terms of the draft contract deposited at my office, which may be inspected during office hours.
The Council will not be bound to accept the lowest or any Tender.
JOHN M. NEWNHAM,
Town Clerk.
Town Hall, Croydon.
October 22nd, 1924. 7279

The Great Indian Peninsula RAILWAY COMPANY, 48, Copthall-avenue, London, E.C. 2, invite TENDERS for:—
1. STATIONERY, &c. ..... Fee 2s. 6d.
2. COPPER TUBES ..... ,, 10s.
3. ZINC INGOTS ..... ,, 2s. 6d.
4. EXPANDED METAL ..... ,, 2s. 6d.
5. WOOD HANDLES ..... ,, 2s. 6d.
Tenders are due by 11 a.m. on 4th November, 1924. Tender forms obtainable at above address. Fees not returnable. 7293

County Borough of Southend-on-Sea.
LEIGH WEST STORM WATER SEWERAGE.
CAST IRON PIPES AND SPECIALS, BRITISH MANUFACTURE.
The Corporation are prepared to receive TENDERS for the SUPPLY of approximately 150 Tons of 18in. C.I. PIPES and SPECIAL PIPES of British manufacture.
General conditions, specification, schedule of quantities and form of Tender, together with detail sketches, may be obtained on and after Thursday, October 23rd, on application to Mr. Robert H. Dyer, Borough Engineer and Surveyor, on payment of a deposit of £2, which will be refunded on receipt of a bona fide Tender and the return of all loaned documents.
Sealed Tenders, addressed to the undersigned and endorsed "Leigh West C.I. Pipes and Specials," are to be delivered to this office on or before Twelve Noon Wednesday, 5th November, 1924.
The Corporation do not bind themselves to accept the lowest or any Tender.
The contractor's attention is directed to the fact that early delivery is an important factor.
H. J. WORWOOD,
Town Clerk.
Municipal Buildings, Clarence-road, Southend-on-Sea.
October, 1924. 7256

South African Railways and HARBOURS ADMINISTRATION.
ELECTRIFICATION OF CAPETOWN SUBURBAN RAILWAYS.
TENDERS are INVITED for:—
83 MOTOR COACH UNDERFRAMES (Steel), and
83 MOTOR COACH BODIES (Wood or alternatively Steel).
The bogies and electrical equipments are not included in this enquiry.
The specification and form of Tender may be obtained from the Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar-square, London, W.C. 2, on and after 24th October, 1924, or the office of the General Manager of Railways, Johannesburg, on and after 13th November, 1924.
The Consulting Engineers, to whom application for further technical information may be made, are Messrs. Merz and McLellan, 32, Victoria-street, London, S.W. 1.
The charge for the specification is £5 5s. for the first copy and £2 2s. each for any further copies. Sums paid for any number of specifications up to three will be refunded on receipt of bona fide Tenders. Sums paid for copies of the specification beyond three will not be refunded.
Sealed Tenders, marked "Tenders for Electrification, Capetown Suburban Railways," are to be addressed to the SECRETARY, Office of the High Commissioner for the Union of South Africa, and lodged at his office in London by Noon on 10th December, 1924.
The Administration does not bind itself to accept the lowest or any Tender. 7278

PUBLIC NOTICES

Epsom Urban District Council. WATERWORKS.
NEW BORING.
The Epsom Urban District Council are prepared to receive TENDERS for the SINKING of a BORING with LINING TUBES 30in. in diameter at the Waterworks, East-street, Epsom.
Contractors desirous of tendering may obtain copies of the specification, general conditions, and form of Tender from the office of Mr. W. Vaux Graham, M. Inst. C.E., 5, Queen Anne's-gate, Westminster, S.W. 1, on payment of the sum of Two Guineas, which will be returned on receipt of a bona fide Tender.
Tenders, endorsed "Tender for New Boring," must be sealed and addressed to the Clerk of the Council, 37, Church-street, Epsom, so as to reach him not later than first post on Monday, 10th November, 1924.
The Council do not bind themselves to accept the lowest or any Tender.
E. G. WILSON,
Clerk.
37, Church-street, Epsom. 7300

Rochester and Chatham Joint SEWERAGE BOARD.
OUTFALL SEWER.
CONTRACT No. 1.
The Board is prepared to receive TENDERS for the CONSTRUCTION of about 6300 Yards Lineal of CONCRETE SEWER CULVERT, size 5ft. high by 3ft. 6in. wide, the whole length being in tunnel, together with deep manholes and other appurtenant works.
Plans may be seen and quantities and form of Tender obtained at the office of the Engineers, Messrs. W. H. Radford and Son, Chartered Civil Engineers, Albion Chambers, King-street, Nottingham (and also at my office as under), from Ten to One each day of the week commencing November 3rd, when Messrs. Radford's assistant will be in attendance), on deposit of Five Guineas (cheque), which will be returned on receipt of a bona fide Tender and the return of the quantities.
The lowest or any Tender will not necessarily be accepted.
Sealed Tenders to be delivered to me at my office as under, on or before Tuesday, November 18th, endorsed "Tunnel Sewer."
By order,
EDWARD B. LEE,
Clerk to the Board.
Town Hall, Chatham.
18th October, 1924. 7227

Southport, Birkdale, and West LANCASHIRE WATER BOARD.
TENDER FOR CAST IRON PIPES.
The above Board are prepared to receive TENDERS from manufacturers for the SUPPLY and DELIVERY of about 90 Tons of 6in. dia. CAST IRON SPIGOT and SOCKET PIPES.
Specification and form of Tender may be obtained from the undersigned, to whom signed Tenders must be returned before the 31st instant.
The Board to not bind themselves to accept the lowest or any Tender.
C. BURTON HDE, A.M.I.C.E.,
Engineer and Manager.
14, Portland-street, Southport,
20th October, 1924. 7252

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of:—
1. CANVAS.
2. WOOD HANDLES.
3. CEMENT TESTING APPARATUS.
Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.
Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Canvas," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 7th November, 1924.
The Directors do not bind themselves to accept the lowest or any Tender.
A charge, which will not be returned, will be made of 5s. for each copy of Specification No. 1, and 2s. 6d. for each copy of Specifications Nos. 2 and 3.
Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, of 3, Victoria-street, Westminster, S.W. 1.
A. MUIRHEAD,
Managing Director.
91, Petty France, S.W. 1.
20th October, 1924. 7291

Epsom Urban District Council. ELECTRICITY DEPARTMENT.
MAN WANTED IMMEDIATELY, FITTER DRIVER. Experience with Diesel and Steam Plant essential. Applicants must be under 40 years of age, and the appointment will be subject to a medical examination. Wages as per No. 10 Area Scale. Applications to be made in writing to
CAPT. A. C. GILLING,
Electricity Works
7307 Church-street, Epsom.

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PUBLIC NOTICES

State Electricity Commission OF VICTORIA.

MELBOURNE, VICTORIA, AUSTRALIA.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Yallourn Power Scheme.

Copies of Tender form and specification will be available upon application to :—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION NO. 24/114.—SWITCHGEAR AND ACCESSORIES.

CHARGE.—£2 2s. for the first three copies of Tender form, conditions of contract, specification and drawings complete. This charge will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than Noon, 20th December, 1924.

R. LIDDELOW,
Secretary.

7281

The Fylde Water Board.

TO PORTLAND CEMENT MANUFACTURERS.

The Fylde Water Board invite TENDERS from Portland Cement Manufacturers for the SUPPLY and DELIVERY of 4500 TONS, more or less, of PORTLAND CEMENT of British manufacture, to comply with the British Standard Specification, to be delivered as required over the period ending May 31st, 1925, at the Fylde Water Board's Private Siding, Long Preston Station (L.M. and S. Railway), and at Blackpool Station.

Particulars may be obtained from the undersigned.

The Board do not undertake to accept the lowest or any Tender.

Tenders must be received by the undersigned on or before Monday, November 10th, 1924.

GEO. F. ATKINSON,
Engineer.

Sefton-street, Blackpool,
20th October, 1924. 7290

Tyne Improvement Commission.

BOILER FOR HYDRAULIC ENGINES.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the SUPPLY and DELIVERY of a BOILER, about 6ft. 10in. dia. by 15ft. 6in. in length, for their Hydraulic Engine House at Albert Edward Dock, North Shields.

Copies of the form of Tender, conditions of contract, specification and drawing may be obtained on application to the undersigned on payment of a deposit of £1, which will be returned on receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed on cover "Tender for Boiler for Hydraulic Engines," must be addressed to "The Chairman, Docks Committee," and delivered at the undermentioned offices not later than Noon on Thursday, the 30th day of October, 1924.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
ALBERT BLACKLOCK,
Secretary.

Tyne Improvement Commission Offices,
Bewick-street,
Newcastle-upon-Tyne.
17th October, 1924. 7263

City and County of Norwich.

APPOINTMENT OF CITY ENGINEER, ARCHITECT AND SURVEYOR.

APPLICATIONS are INVITED for the POSITION of CITY ENGINEER, ARCHITECT and SURVEYOR to the Norwich Council.

The commencing salary will be £800 per annum (plus the appropriate Civil Service bonus). Means of locomotion will be provided or a reasonable sum allowed.

Preference will be given to applicants who are under the age of 45 and who are Corporate Members of the Institution of Civil Engineers.

Terms and conditions of appointment and form of application can be obtained from the undersigned.

Applications, endorsed "City Engineer, &c.," together with copies of not less than three recent testimonials, to be sent to the undersigned not later than the 12th November, 1924.

Canvassing will disqualify.

ARNOLD H. MILLER,
Town Clerk.

Guildhall, Norwich.
October, 1924. 7210

SITUATIONS OPEN

WANTED, First-class ENGINEERING STOREKEEPER in large works employing upwards of two thousand men. Only first-class men need apply.—Address, 7312, The Engineer Office. 7312 A

WANTED, a WORKS MANAGER, who is thoroughly up to mass production, to Take Charge of Works producing a repetition article of an engineering nature; 500 men employed.—Address, 7257, The Engineer Office. 7257 A

WANTED by Firm of Railway Contractors, a CASHIER for Railway Construction Contract in the Midlands.—Address, giving particulars of experience, age, references, and salary required, P9709, The Engineer Office. P9709 A

WANTED by Firm of Railway Contractors, an AGENT and ENGINEER for Railway Constructional Contract in the Midlands.

Applicants must have had experience with contractors on all classes of railway work, particularly of heavy rock excavation.

Address, with particulars of experience, giving age, references, and salary required, P9707, The Engineer Office. P9707 A

WANTED, Experienced ENGINEER, with Thorough knowledge, commercial and technical, of Air Pre-heating, Forced and Induced Draught, and Ventilation. Salary and commission on turnover. Knowledge of French essential.—Address, 7265, The Engineer Office. 7265 A

WANTED, First-class TRAVELLING REPRESENTATIVE with good connection amongst gas and commercial manufacturers for engineering works in Glasgow district.

State experience, qualifications, and salary required and give reference.

Apply by letter to Messrs. MANN JUDD GORDON and CO., 142, St. Vincent-street, Glasgow. 7280 A

AERIAL ROPEWAYS.—FIRM Specialising in Aerial Ropeways REQUIRE the SERVICES of a thoroughly experienced ENGINEER to Take Over the Management. Applicants must be able to supervise estimating and constructing of Ropeways and Transporters of all kinds and only men with previous specialised experience, details of which should be given, need write Box 1068, Sell's Advertising Offices, Fleet-street, E.C. 4. 7316 A

CHIEF INSPECTOR WANTED in Well-equipped Works, London district. Must have had thorough practical training as machine operator, with knowledge of heat treatment, materials and material tests, also limits required for aero-engine work. Only those who have held responsible positions in firms controlled by A.I.D. acceptable.—Address, stating age, experience, salary expected, 7305, The Engineer Office. 7305 A

ENGINEER WANTED, with Some Knowledge of up-to-date Rolling Mill Practice and used to the control of men. Reply by letter only, stating age, experience, and salary expected.—Address, P9717, The Engineer Office. P9717 A

QUALIFIED ENGINEER REQUIRED for North of England; must have experience of Modern Road Construction. Reply, stating full particulars of experience and recent testimonials.—Apply, Box No. P9693, Messrs. W. H. Smith and Son, 74, Sankey-street, Warrington. P9693 A

SITUATIONS OPEN (continued)

RATE FIXER WANTED in South of England; must have had wide experience in fixing piecework prices for machinery, fitting and erecting all classes of engine work. Only those with proved experience need apply.—Write, stating age, salary required, and where experience gained, Box 1948, Sell's Advertising Offices, Fleet-street, E.C. 4. 7274 A

REINFORCED CONCRETE DESIGNERS REQUIRED, competent and with specialist experience in calculations and details for all classes of Reinforced Concrete Structures. State age, experience, salary required, &c., in confidence.—Address, 7282, The Engineer Office. 7282 A

TEA PLANTING.—An Important TEA COMPANY has a VACANCY on its European staff for a YOUNG GENTLEMAN (aged 23-24 and unmarried) with Engineering Experience and with a knowledge of Crude Oil Engines and Electric Light installations, to become a TEA PLANTER on its gardens in Assam. The position would be under a three years' agreement, commencing from the date of arrival at the gardens and salary for the first year would be at the rate of Rs. 225 a month, rising by annual increments of Rs. 25 a month to Rs. 275 a month in the third year. Passage to the gardens would be paid by the Company.—Applications should be addressed to Box "ASSAM," care of Davies and Co., 66, Bishopsgate, London, E.C. 2, and should contain full particulars as to age, education, and engineering experience. 7301 A

WORKS MANAGER in Engineering Works, 35 to 40 years of age. Thoroughly practical and with good modern shop experience in manufacture of heavy type machinery; 250 to 300 workpeople employed.—Address, with full particulars of experience and copies testimonials, stating age and salary required, P9695, The Engineer Office. P9695 A

WANTED, Experienced RAILWAY CARRIAGE and WAGON DRAUGHTSMEN.—Apply by letter, stating experience and salary required, THE BIRMINGHAM RAILWAY CARRIAGE and WAGON CO., Ltd., Smethwick. 7286 A

WANTED, First-class DRAUGHTSMEN in Connection with Handling Plants. Repeat experience desirable.—Apply, ROBERT DEMPSTER and SONS, Ltd., Rose Mount Ironworks, Elland, Yorks. 7284 A

WANTED, First-class MECHANICAL DRAUGHTSMAN, thoroughly experienced in design of High-speed Gearing, preferably of heavy type. Good technical training essential. Preference given to man with wide knowledge of mechanical problems relating to heavy traction. Applications from capable men only will be considered. State fully experience, age, and salary required.—Address, 7304, The Engineer Office. 7304 A

AN Experienced RAILWAY CARRIAGE and WAGON DRAUGHTSMAN, accustomed to Preparation of Designs for tendering purposes for home and export; expert Checker and able to Take Charge of Contracts. A JUNIOR RAILWAY CARRIAGE and WAGON DRAUGHTSMAN is ALSO REQUIRED. Applications treated with strict confidence.—Address, 7291, The Engineer Office. 7291 A

DRAUGHTSMEN (Several Experienced) WANTED AT ONCE for Power Plants, Conveying, Elevating and Crushing Machinery, also Structural Work for factory purposes, including Steel Reinforced Concrete and Brickwork.—Address, stating age, experience, and salary required, 7268, The Engineer Office. No original testimonials to be sent. 7268 A

DRAUGHTSMAN WANTED, with Experience in Screening Plants, Headgears and Steel Structures. Good scope and substantial salary to suitable applicant.—Address, 7246, The Engineer Office. 7246 A

SEVERAL GOOD SENIOR and JUNIOR DRAUGHTSMEN REQUIRED for Aeronautical Work by S. E. SAUNDERS, Ltd., East Cowes, Isle of Wight. Give particulars of experience and salary. 7196 A

HEAD DRAUGHTSMAN (Structural), Steel; Theoretical and practical experience. Age between 30 and 40. Salary about £450/£500, according to qualifications.—Address, stating experience, 7302, The Engineer Office. 7302 A

HEAD DRAUGHTSMAN, with Wide Experience in the design and application of all classes of Centrifugal Pumps and High-speed Engines for Marine and Land Work; able to control staff efficiently and economically. State age, full details of experience, and salary expected.—Address, 7308, The Engineer Office. 7308 A

WANTED by Firm of Railway Contractors, a FOREMAN FITTER for Railway Construction Contract in the Midlands. Applicants must be fully conversant with repairs to Steam Navvies, Locomotives, Cranes and Drilling Plant, &c.—Address, giving particulars of experience, age, references, and wages required, P9710, The Engineer Office. P9710 A

WANTED by Firm of Railway Contractors, a WALKING GANGER for Railway Construction Contract in the Midlands. Applicants must have had previous experience of railway work, particularly of heavy rock excavation.—Address, giving particulars of experience, age, references, and wages required, P9708, The Engineer Office. P9708 A

WANTED, FOREMAN for Finishing Department; must have good organising abilities. Capable of taking over finished bodies and chassis of motor cars and assembling them. Previous experience in this class of business essential. Write, giving full particulars as to experience, age, &c. These particulars are to be given in the briefest possible manner. Copies of testimonials only to be sent. Salary about £350 per annum.—Address, 7253 The Engineer Office. 7253 A

WANTED, MACHINE SHOP FOREMAN, Accustomed to heavy work of a high-class character. Good knowledge of Planing. Turning and Boring essential; experience in Heavy Cut Gearing desirable. —Address, stating age, previous experience, and wages expected, 7306, The Engineer Office. 7306 A

WANTED, WORKING CHARGE HAND for Heat Treatment Department in Motor Vehicle Works. State age and wages required.—Address, 7285, The Engineer Office. 7285 A

FIRST-CLASS MACHINEMAN MECHANIC REQUIRED, Derbyshire district.—Address, stating age, experience, and wages required, 7309, The Engineer Office. 7309 A

SITUATIONS WANTED

CONSTRUCTIONAL AND PRESSED STEEL WORK.—WORKS MANAGER DESIRES CHANGE. Man of exceptional experience and characteristics. Accustomed to great responsibility.—Address, P9701, The Engineer Office. P9701 B

ENGINEER SALESMAN, Many Years' Experience with firm of world-wide reputation, highest qualifications, successful record and first-class references, DESIRES APPOINTMENT.—Address, P9705, The Engineer Office. P9705 B

ENGINEER (22), Public School Education, 3 Yrs. pupilage with leading firm and full theoretical training, Lond. Matric., A.M.I.E.E. exam. (April, 1924), candidate A.M.I.M.E. exam. (Oct., 1924), REQUIRES progressive POST, commn. or techn., home or abroad.—Address, P9711, The Engineer Office. P9711 B

ENGINEER REQUIRES POST with Prospects; general experience, gas and steam engines, refrigeration, machinery repairs, knowledge drawing design; student technical institute, 23.—Address P9724, The Engineer Office. P9724 B

GENERAL MANAGER (41) DESIRES CHANGE; 24 years' experience of manufacture and sale of all types of waterworks fittings, eight years last position four years present, experience gained in foremost British firm. Would invest capital in sound concern giving scope for knowledge and experience and seat on board. University graduate, &c.—Address, P9725 The Engineer Office. P9725 B

SITUATIONS WANTED (continued)

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Low Temperature Carbonisation Test.

In reviewing the other day the annual report of the Department of Scientific and Industrial Research, we recorded the fact that the Department had been empowered by the Government to test at the public expense approved plants for the low-temperature carbonisation of coal. Without attempting to pronounce on the commercial possibilities of any such plant so tested, the Department is authorised to conduct the test so as to be able to place in the hands of those interested accurate technical information regarding the quality and quantity of the yields, the "throughput" of the plant, the working temperatures, the general ease of working, and so forth. The first report of a test conducted by the Department under this scheme was issued as an official Government publication on Monday. It relates to tests conducted on July 22nd to 24th this year on a standard unit of the Parker plant for the low-temperature carbonisation of coal at the Barugh Works, near Barnsley, of Low-Temperature Carbonisation, Limited. Dr. C. H. Lander, Director of Fuel Research, reporting generally on the tests, states that the products obtained were satisfactory, both in quantity and quality, and were on the average slightly better than the yields obtained from similar coal at the Fuel Research Station, East Greenwich. With all the thirty-two retorts working, the throughput of the plant would be 50 tons per day, and would be in accordance with that claimed. Certain defects showed themselves in the plant during the tests, but there should be no difficulty, it is considered, in overcoming them in future designs. Per ton of coal as charged, containing 5.2 per cent. of moisture, the test results showed the following yields:—Coke, 13.92 cwt.; gas, 5620 cubic feet, representing 39.6 therms; tar, 18.62 gallons; liquor, 26.0 gallons; sulphate of ammonia, 13.55 lb. By scrubbing the gas, 1.78 gallons of crude spirit were recovered per ton of coal, and by distilling the tar to 170 deg. Cent., an additional 1.09 gallon was obtained. This total volume of crude spirit, 2.87 gallons, yielded 2.16 gallons of refined spirit. The tests were carried out with Dalton Main coal, and covered the carbonisation of 92 tons.

Australian Locomotives.

It is credibly reported that the New South Wales Railway Commissioners have placed a contract with the Clyde Engineering Company, of Sydney, for thirty-five locomotives, at a total cost of £391,000. The lowest British tender is said to have been submitted by the North British Locomotive Company, Limited, the figure being £351,000, including the tariff duty of £72,000. By placing the work with the Sydney firm, the Commissioners are thus apparently expending £40,000 more than they need have done, and are depriving the Customs of nearly twice that sum. In addition, it seems they are also accepting slower delivery. The question is being asked, as it has been asked before in a similar case involving the Commonwealth, whether it was the intention from the outset to place the work with a native firm, and, if so, whether it is fair to ask overseas firms to incur considerable expense in tendering for a contract which they have no chance of securing.

Wireless Beacons.

With the permission of Trinity House, the Marconi International Marine Company has erected the first experimental wireless beacon on the coast of Great Britain. It is situated at Nash Point, between Swansea and Cardiff. Severe practical tests over a period of six months have, we understand, given very satisfactory results. The installation consists of a ½-kilowatt quenched spark transmitter, which automatically transmits its own call sign on a wave length of 1000 m. It is operated by means of an Austin paraffin-petrol engine. The power used is sufficient to enable bearings to be obtained by means of a Marconi marine direction finder at a distance of 50 miles, but the beacon does not interfere with broadcast reception outside a range of 3 miles. Already the installation has proved very useful in the Bristol Channel, where opportunities to make use of a direction finder have been very limited. The trials are said to have shown that transmitters of this type will ultimately prove of great assistance on many other parts of the coast.

Scrapping of Japanese Warships.

Under the Washington Treaty for naval limitation, Japan was required to discard fourteen capital ships then completed or under construction. How far matters have progressed in this direction is explained in an official statement issued by the Tokyo Navy Department. The Asahi, stripped of guns and armour, is now serving as a training ship, and the Shikishima, after being disarmed, is to be used in the same capacity. From the Mikasa the turrets have been removed; her engines are to be rendered useless, but the ship herself is to be preserved as a souvenir of the Russo-Japanese War, in which she was Admiral Togo's flagship. The Aki and the Satsuma were dismantled and then used as targets for gunnery and torpedo practice, both being sunk early in September. The Hizen, with guns taken out but conning-tower and side armour left in position, is retained as a target ship. Five other ships—Iwami, Ikoma, Ibuki, Kashima, and Katori—are being broken up. The Settsu is stripped of armament, but will be utilised as a target, probably equipped with wireless control. The Tosa and the Amagi are to be broken up and the material sold, while the Kaga is being converted into an aircraft carrier. Of the foregoing ships, all save the four last mentioned were pre-Dreadnoughts, and therefore obsolete. The Settsu was the first all-big-gun ship built for the Japanese Navy. The Kaga and Tosa were battleships of the post-war programme, and if completed would have displaced 40,000 tons, with an armament of ten 16in. guns. The Amagi, of the same programme, was designed as a battle-cruiser of 44,000 tons. She was to have been rebuilt as an aircraft carrier, but her hull was shattered by the earthquake of a year ago. A sister ship, the Akagi, is now being completed as an aircraft carrier.

Power Station Wages.

The special tribunal which was set up under the National Joint Industrial Council for the Electricity Supply Industry to consider the recent application of the workers for an all-round advance of wages, has come to the conclusion that no case has been made out for such an advance. It is recommended, however, that in certain cases the District Councils should be asked to reconsider their existing rates of pay. The Joint Council will meet in London on Friday, November 14th, to consider the report of the tribunal, and no action will be taken by either side until the Council has reached a decision. Dealing with the argument of the trade union's representatives to the effect that the advance in wages asked for would only amount to one-twentieth of a penny per unit of power, the report of the tribunal states that this figure is equal to an addition of 5 per cent. to the cost of generation and distribution, and that by the clauses in contracts at least one-half of this amount would be automatically imposed on the consumer, and in the aggregate it would represent a substantial burden upon industries already suffering from depression. It is considered that the increased level of wages above that of 1914 is in excess of the increased cost of living.

Standardisation in American Shipbuilding.

An active programme of standardisation is being carried out by the American Marine Standards Committee with a view to assisting shipbuilding and shipping in the United States. At present there are three technical committees at work dealing respectively with hull details, engineering, and the operation of ships. It is now announced that the Executive Board of the Standards Committee has appointed a fourth Committee, the task of which it will be to formulate instructions and regulations to ensure the stability of ships, not only in the stages of design and construction, but also when loaded with cargo. The *personnel* of the new Committee includes well-known naval architects and representatives of the American classification societies and insurance companies. It will be some months before the report of this new Committee is completed, but the work of the three technical committees previously mentioned is proceeding rapidly, and recommendations as to standardising a number of items are said to be nearly ready to be referred to shipbuilding concerns and shipping companies for action to be taken. Altogether some 129 companies, including technical organisations and manufacturing groups, have been enrolled as associate members of the American Marine Standards Committee.

The Zeppelin Works.

A considerable amount of discussion is proceeding in France and Germany regarding the future of the Zeppelin airship works at Friedrichshafen. Now that the ZR 3—or Los Angeles, to give her her new name—has been safely delivered to the United States Government there are those in France who urge that the cessation of activity at the works as stipulated in the Versailles Treaty should be enforced. The establishment has only been allowed to continue to the present moment in order that the ZR 3 might be completed for the American Government in compensation for the airships which in 1919 the Germans destroyed rather than surrender them as demanded to the Allies. The French Under-Secretary for Aeronautics is reported to have expressed himself strongly in favour of the rigid carrying out of the Treaty terms. Others, however, hold that the present is a bad moment for executing the clause on the ground that Germany for the time being has become jubilant—unreasonably jubilant—over the performance of the latest airship, and because to insist upon the closing of the works would open the door to the criticism that the Allies prefer the execution of the Treaty to the progress of human achievement. Possibly with a view to encouraging those who favour the works being allowed to continue, the suggestion is being circulated that Germany might be allowed to build an airship for France on account of reparations, just as she has done for the United States. The position would appear to be somewhat complicated by the fact that the Zeppelin Company, anticipating presumably the closing down of its works, has been disposing of its patent rights to foreign firms. Some time ago it was definitely announced that such a course had been followed in favour of the Goodyear Tyre and Rubber Company, Akron, Ohio. It is now reported that the French rights have been acquired by the Société Anonyme de Navigation Aerienne.

The Greenock Shipyard Explosion.

Some further information is now available concerning the unusual explosion which took place in the main street of Greenock on Thursday last, while a lorry loaded with cylinders of oxygen and other gases was being unloaded at the entrance to the yard of the Greenock and Grangemouth Dockyard Company, Limited. The explosion was very sudden and considerable damage was done to the buildings in the vicinity. A number of persons were injured, including the passengers of two tramcars which happened to be near the yard when the accident took place. At first the explosion was attributed to the bursting of an oxygen cylinder, but in a statement which has since been issued by the British Oxygen Company, Limited, it is explained that the explosion was not brought about by the failure of such a cylinder, but by a cylinder of dissolved acetylene, which was either dropped off the motor lorry or fell whilst the lorry was being unloaded. The statement goes on to say that for some reason which may have to be investigated the cylinder containing the dissolved acetylene was ripped open and travelled a distance of some yards along the road. What was the exact cause of the ignition of the mixture of acetylene and air which produced the subsequent violent explosion has yet to be ascertained.

A New Building Material.

On Monday last the official opening of the new works of the Fyfe-Stone Company, Limited, took place at Coltmuir Quarry, Bishopbriggs, Glasgow. It is intended to produce at these works synthetic stone in standard building units. The makers claim that the specially constructed 24in. Fyfe-Stone block can be built up in about half the time which would be necessary for brickwork, and as such blocks can be sand or granite faced in the process of manufacture, no rough-casting is required to keep out dampness. Five heavy pressing machines of new design have already been installed, and it is hoped with this plant to turn out 2400 standard 24in. blocks per day. Such a contribution to the production of Scottish building materials should be an important one, for stone plays a large part in most of the Glasgow building schemes. It is estimated that at least 52,000 new houses are now required in Glasgow, and as the population of that city is increasing at the rate of about 10,000 per annum, any system of accelerating the building programme at a moderate cost should be assured of success.

Diesel Engine Castings.

Clyde engineers are well to the fore in all matters pertaining to the design and construction of marine oil engines. It was not surprising therefore that there was a large attendance at a joint meeting of the Scottish Section of the Institution of Mechanical Engineers and the Association of British Foundrymen which took place in Glasgow on Thursday last, the 16th inst. The object of the meeting was to bring together the engineer and the foundryman, and to afford an opportunity of discussing the various problems associated with the production of sound oil engine castings. The result which the promotors sought to bring about was helped by the reading of four short papers on various branches of the subject. Professor A. L. Mellanby dealt with the temperatures attained, and the conditions under which cast iron was called upon to work in oil engine cylinders. The characteristics of cast iron from the point of view of the metallurgist were described by Professor A. Campion; while Mr. James Richardson introduced the question of the relation of oil engine design to foundry practice. On behalf of the foundrymen, Mr. William Bell discussed the design of oil engine castings from the moulder's point of view. This intimate meeting together of those engaged in the design and production of oil engine castings is to be warmly welcomed, for it is now generally recognised that the success of the marine internal combustion engine is closely bound up with the production of castings strong enough to resist high cylinder pressures and temperatures, which at the same time combine good wearing properties with resistance to growth when they are subjected to high temperatures over continuous and lengthy periods.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. XXVII.*

GENERAL ENGINEERING EXHIBITS.

BROWETT, LINDLEY AND CO., LIMITED.

Two steam engines and a gas engine of their standard designs are exhibited by Browett, Lindley and Co., Limited, Manchester. The gas engine illustrated by Figs. 503 and 505 is of the four-crank four-cylinder single-acting type, with cylinders all in line, and is coupled direct, on a combination base plate, to a dynamo built by the Lancashire Dynamo and Motor Company, Limited. It has cylinders 12in. diameter by 11in. stroke, and the normal speed of the set is 428 revolutions per minute, at which speed the output is 100 kilowatts. The general features of this type of engine are fairly familiar to readers of THE ENGINEER. They resemble as far as possible those of the totally enclosed vertical steam engines made by Browett, Lindley and Co. Referring to the sectional drawings, Fig. 505, it will be noted that although all the working parts are totally enclosed, they are comparatively easy of access. It will be observed that the cylinder covers are devoid of attachments, such as valves and valve mechanism, and, hence, that they can be easily removed when it is desired to get at the pistons. The connecting water pipe joints are arranged externally with the same object in view. The inlet and exhaust valves, which are of the composite type, with steel spindles and cast iron heads, are operated from cams on a cam shaft, which is housed within the engine frame. The cam roller guides are of the piston type, working in small renewable cylinders supported in the frame and amply lubricated. It will be observed that the inlet valves are fitted in removable cages, and are guided by a piston type collar, while the exhaust valves can be withdrawn through the inlet valve ports. Means for adjusting the clearance between the valve stems and operating rods are provided outside the frame. All the working parts, including the governor, are lubricated at a pressure of 10 lb. to 15 lb. per square inch by means of oil supplied by a valveless pump placed in the crank pit, the oil being passed through strainers in the sump. The pump is actuated by an excentric on the crank shaft.

Well-proved steam engine practice has been closely followed in the design of the frame and the bed, and doors of ample proportions are provided for inspection purposes. The bed is constructed on the double-girder principle, and the base and frame are divided on the centre line of the crank shaft, thus permitting the latter to be lifted out vertically. The crank shaft is of Siemens-Martin open-hearth forged steel, with the throws cut from the solid, and the half coupling flange is forged solid with the shaft. The shaft is carried in cast iron shell bearings, lined with white metal. The governor on the crank shaft is totally enclosed. It is of the weight and spring type, and operates a governor valve of the double-beat type when producer gas is used. By means of this valve mechanism, the quantities of both air and gas entering the cylinders can be regulated according to the load. The construction of the valves is such that they can be adjusted to control the mixture while the engine is running. The inlet manifold is designed

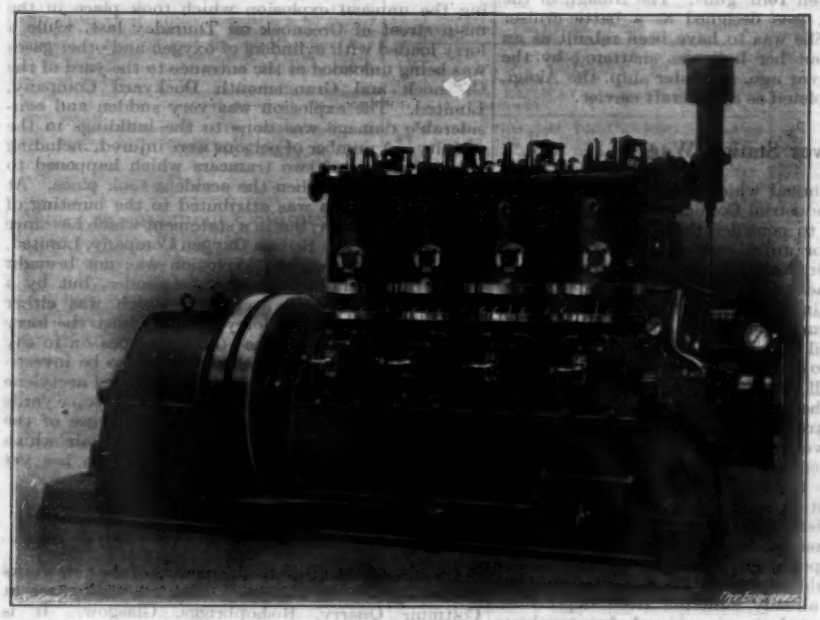


FIG. 503—FOUR-CYLINDER GAS ENGINE—BROWETT, LINDLEY

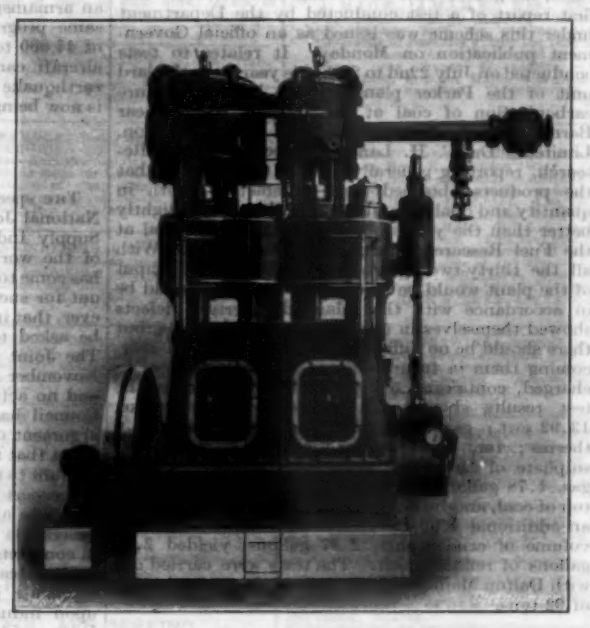


FIG. 504—AIR COMPRESSOR—BROWETT, LINDLEY

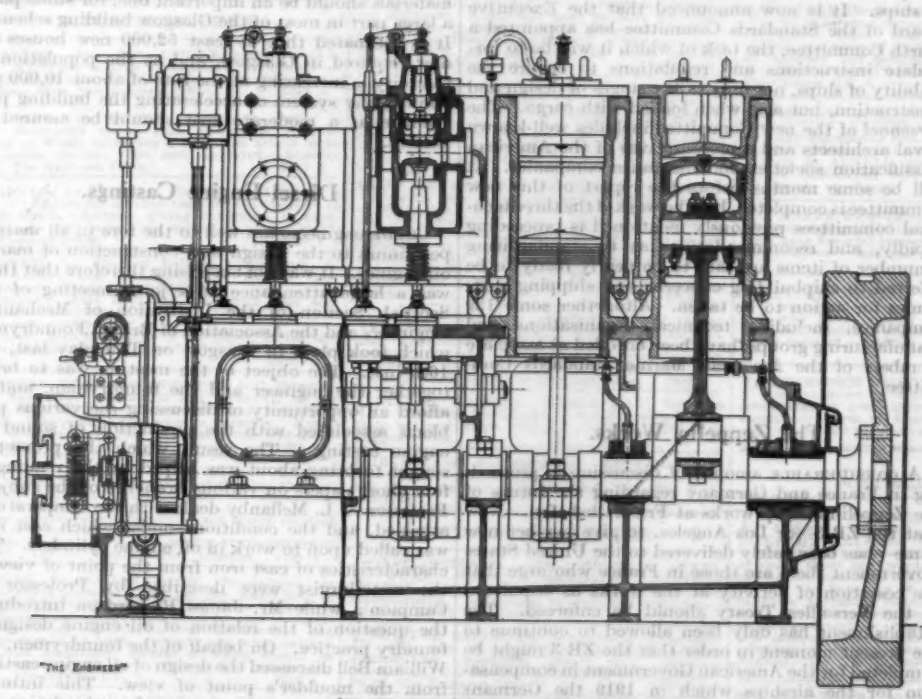


FIG. 506—LONGITUDINAL AND CROSS SECTION OF GAS ENGINE—BROWETT, LINDLEY

* No. XXVI appeared October 17th.

so that the supplies of air and gas are kept separate until they reach the inlet valve. The ignition is by means of high-tension magnetos fitted with impulse starters. The magnetos are in duplicate, and are operated by worm gearing from the cam shaft, as shown in the detail drawing, Fig. 506.

The dynamo is wound with interpoles, and is capable of an output of 100 kilowatts, at 220–250 volts pressure at the normal engine speed. It is fitted with a back-of-board type of shunt field regulator.

A steam-driven air compressor, shown by this firm, is of the two-crank enclosed vertical two-stage pattern. The steam cylinders are 16½in. by 26in. diameter by 13in. stroke, and the air cylinders are 28in. by 17½in. diameter, with a similar stroke to

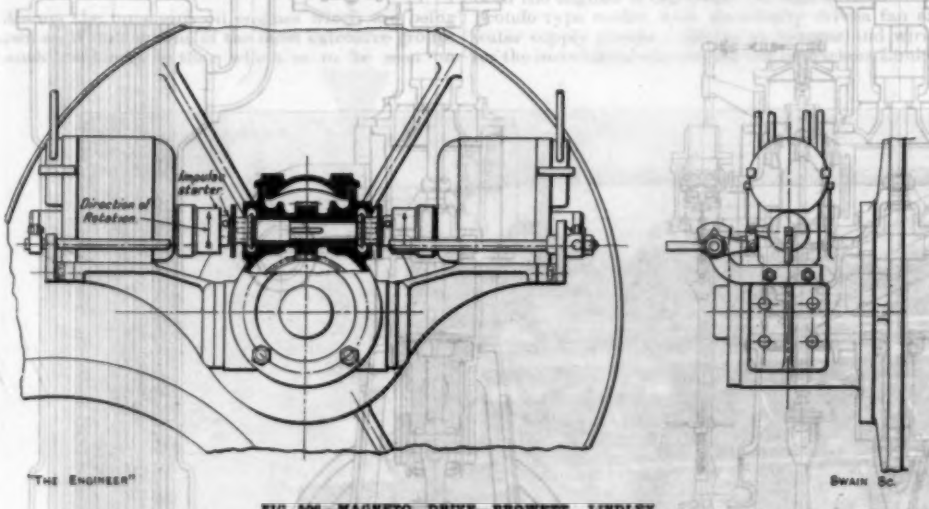


FIG. 506—MAGNETO DRIVE—BROWETT, LINDLEY

that of the steam cylinders. The capacity of the set is 2000 cubic feet of free air per minute, compressed to 80 lb. to 100 lb. per square inch, at an engine speed of 270 revolutions per minute. Illustrations of this set are given in Figs. 504 and 508. An interesting feature of this plant is the automatic speed-reducing and control gear, with unloading device for the air cylinders—Fig. 507. This control gear comprises two independent air-governing devices, one of which automatically reduces the speed of the compressor when the demand for air falls below the normal quantity, and the other totally unloads the compressor when no air at all is required. The speed-reducing governor begins to operate at a pressure slightly lower than that required to actuate the unloading valve, and the amount of steam passing to the valve ports, and thus reduces the speed of the compressor by the necessary amount. The amount by which the valve ports are closed depends upon the reduction of speed required, and the degree of opening can be regulated by hand at the adjustable stops H on the valve spindle. When the air pressure in the receiver or main again falls to the predetermined limit the weighted plunger in the air governor D descends and shuts off the compressed air from the top of the piston in the speed control governor G. The piston returns to its original position by means of a compression spring J, and the valve ports are opened again to the full extent, thus permitting the full quantity of steam to pass to the steam cylinders. The action of the unloading valve is as follows:—When the demand for air falls or is temporarily suspended, the air pressure in the receiver or main rises above the predetermined limit, and when the pressure has increased by some 3 to 5 per cent. the air passes from the receiver through the air strainer, previously referred to, to the underside of a centrally weighted plunger in the other air governor K. The plunger rises, uncovering a port L and permitting the excess air to pass through a pipe M to the top of a piston in the unloading valve N. This causes the piston and rod, to which it is attached, to descend and release a valve which permits the air to pass to the atmosphere instead of going to the receiver. When the air pressure in the receiver or main again falls to the predetermined limit, the weighted plunger in the air governor K will descend and shut off the compressed air from the top of the piston in the unloading valve N. The piston is then returned to its original position by means of a spring P, closing the valve against the atmosphere and allowing the air to pass to the receiver again. The unloading valve can be operated by hand when starting up the compressor from rest, in which case the air drawn in passes through the air unloading outlet to the atmosphere without being compressed. When the desired speed has been attained, the valve is closed and the air is compressed and delivered to the receiver.

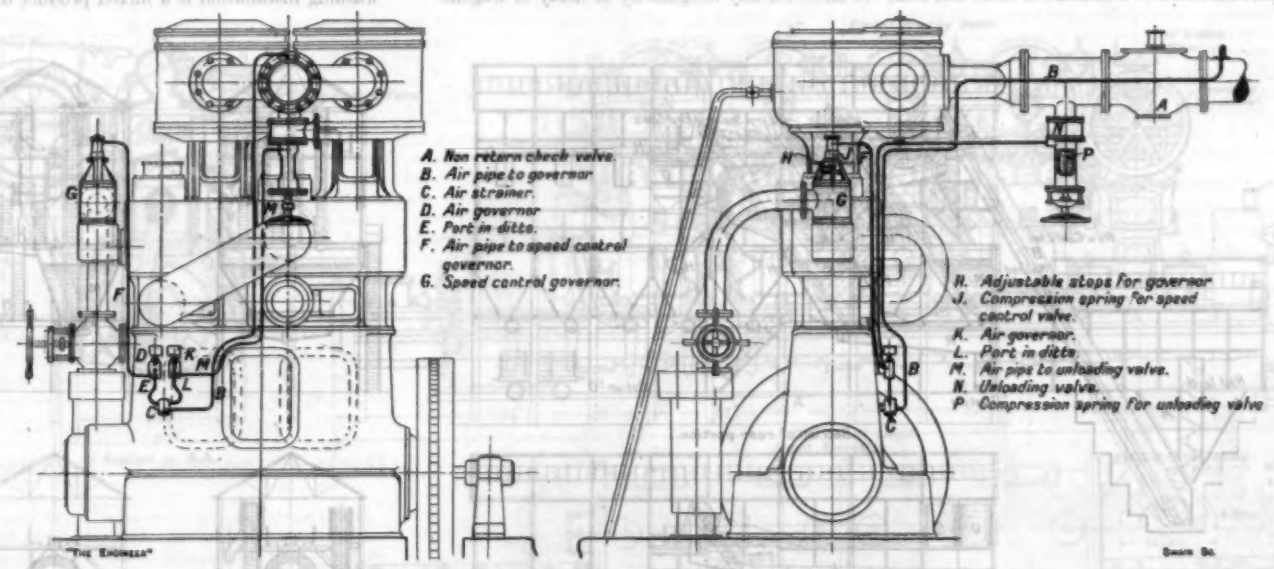

A. Non return check valve.
B. Air pipe to governor
C. Air strainer.
D. Air governor.
E. Port in ditto.
F. Air pipe to speed control governor.
G. Speed control governor.
H. Adjustable stops for governor
J. Compression spring for speed control valve.
K. Air governor.
L. Port in ditto.
M. Air pipe to unloading valve.
N. Unloading valve.
P Compression spring for unloading valve
"The Engineer"
Swain Sc.

FIG. 507—CONTROL GEAR OF AIR COMPRESSOR—BROWETT, LINDLEY

In addition to the above-mentioned air-governing devices, a steam throttle valve and centrifugal shaft governor, which prevent the normal rated speed of the compressor being exceeded by more than about 3 per cent. are fitted. The valves of the compressor are of the Rogler-Hoerbiger type, made of tempered steel of extreme lightness, with very small lift, thus eliminating wear and ensuring absence of shock when closing. These valves are automatic, and, together with their seats, can be readily removed for inspection. The air cylinders and covers are water jacketed and intercoolers are fitted between the cylinders in multi-stage types.

A third exhibit by Messrs. Browett, Lindley and Co. is a two-crank two-valve compound enclosed forced-lubrication double-acting steam engine of the vertical type. This engine has cylinders, 10in. and 15in. diameter by 8½in. stroke, and is designed for a speed of 500 to 550 revolutions per minute. It is complete with a half-coupling for driving a 100-kilowatt dynamo direct. It is provided with piston valves, and the gear is operated direct from the crank shaft by means of excentrics. The high-pressure piston is made of cast iron, and the low-pressure piston of steel. All motion work, is entirely enclosed within the frame and base of the engine, and is lubricated by oil under pressure supplied from a valveless pump placed in the lower part of the bed and operated from one of the main excentrics. The governor is of the centrifugal type fixed to the crank shaft, and acts directly on the throttle valve, which is of the double seated type. In addition to operating the throttle valve, the governor also actuates a variable expansion gear. Engines of this class are built with one, two or three cylinders up to 1000 kilowatts capacity.

Butterley Ironworks.

A coal washing plant exhibited by the Butterley Ironworks, of Derby, is manufactured under the Rheolaveur licence, and is illustrated by Fig. 509, which represents a large plant put up in the Midlands for dealing with 125 tons of coal an hour.

The essential characteristic of the Rheolaveur system of washing coal, for the extraction of shale and other impurities, is the use of a gradually decelerated, approximately horizontal, current of water. The coal and the water are fed down a trough and the retardation of the current is effected by gradually reducing the inclination of the trough. The moving mass quickly becomes stratified, with the heavy shale at the bottom and the coal on the top. In order to remove the shale as it separates out slots are cut in the bottom of the trough, but if they were left open the consequent disturbance in the current of water would tend to allow coal to escape through them along with the shale. For this reason a closed chamber is fixed beneath each of the slots and has an adjustable opening or gate at the bottom. The chamber is also provided with a water supply. The gate is set so that it will just pass the amount of shale falling into the chamber through the slot, and the water supply is adjusted to produce a very gentle upward flow through the slot. The result is that the shale all tumbles down through the slot, but the coal is borne on along the trough by the horizontal current. The apparatus

power required for running the compressor lightly loaded is reduced to a minimum. The advantage of this method of governing is that it is not necessary to stop the compressor owing to intermittent demands. When the demand for air falls or is temporarily suspended, the pressure in the receiver or air main rises above the predetermined limit, and the air passes from the receiver beyond the non-return valve A by means of a pipe B through the air strainer C to the underside of a centrally weighted plunger in the air governor D. The weight of this plunger is such that it is capable of withstanding the predetermined pressure only, whilst any excess pressure causes the plunger to rise and uncover the port E, which permits the air to pass through a pipe F to the top of the piston in the control governor G, causing the piston to descend. Attached to this piston by means of a rod is a valve which, on descending, restricts the

is, of course, repeated a sufficient number of times to ensure that clean coal is delivered at the end of the trough. A slight modification of the chamber is, however, necessary for handling the larger sizes of material, as there would be too great an escape of water if the gate were opened wide enough to pass these sizes. As a consequence there is a second chamber or hopper beneath the gate, and the hopper is discharged intermittently as it is filled.

By means of this apparatus it is said to be possible to reduce the ash content of the coal to no more than 2 per cent. above the fixed ash in the coal, while the shale taken out will have only from 0.9 to 1.7 per cent. of coal in it. At the same time the sulphur content of the coal may be reduced from 1.6 per cent. down to 1.11 per cent.

In the case of the plant illustrated by Fig. 509 the raw coal is brought from the screening plant by a

conveyor to the hopper A. This hopper may also be charged from wagons on the railways on either side should the necessity arise. The coal is raised from the hopper by means of an elevator B to the head of the washing installation C. This comprises a trough fitted with two sealed Rheolaveur chambers, the first of which extracts shale. This shale is raised by the elevator D and is discharged into shale cistern E. The second apparatus extracts a mixture of shale and coal, which is raised by the elevator F and discharged into the head of trough C to be re-washed. By this arrangement of re-washing a cycle is obtained which ensures that all the remainder of the shale is extracted in the second apparatus, as some coal is allowed to come with the shale and is then recovered by re-washing.

The washed coal passes over the end of the trough C on to the revolving screen G, which classifies the coal into five sizes, viz., 0–$^{5}/_{16}$in., $^{5}/_{16}$in.–$\frac{3}{4}$in., $\frac{3}{4}$in.–1in., 1in.–1$\frac{1}{2}$in., 1$\frac{1}{2}$in.–2$\frac{1}{2}$in. The four largest sizes pass into their respective bunkers H, H_1, H_2, and H_3. Each of these hoppers is of 35 tons capacity and all have spiral shoots. Sufficient storage is provided in these hoppers to allow for any irregularity or delay of wagons.

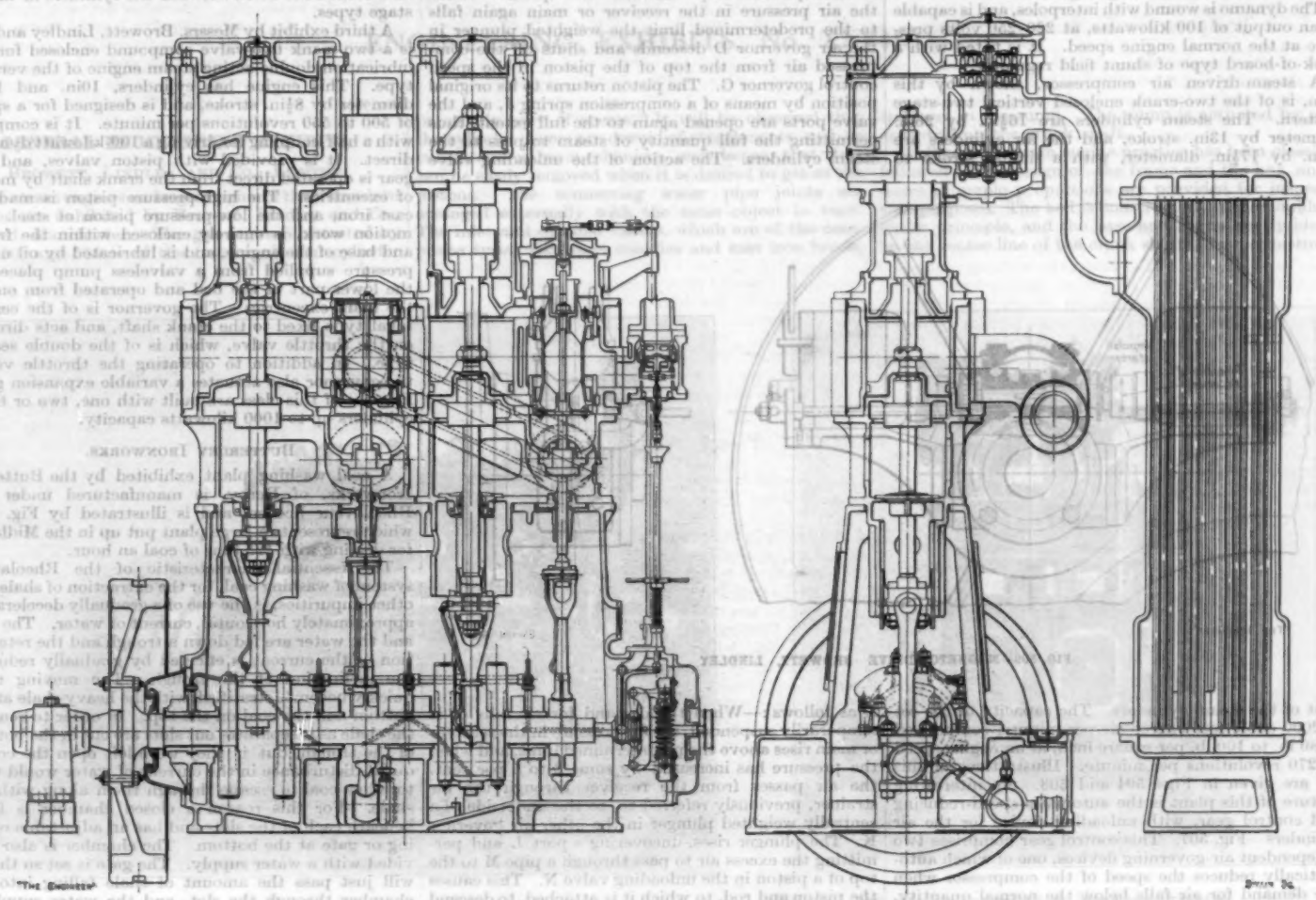


FIG. 508—STEAM-DRIVEN AIR COMPRESSOR—BROWETT, LINDLEY

The 0–$^{5}/_{16}$in. coal, together with the water, passes to the fine coal re-wash cistern J, whence it is raised by means of the fine re-wash elevator K to the head of the fine coal washing installation L. This is composed of three superimposed troughs fitted with open discharge Rheolaveur apparatus. The washed coal passes over the end of the two top troughs into the fine washed coal hopper M, and is then raised by means of another elevator to the distributing drainage conveyor N, which deposits the washed material in the six storage drainage bunkers below, having a total capacity of 450 tons.

The product passing over the third trough of the washing installation is a mixed product of shale and coal, and is conducted back to the re-wash cistern J to be re-washed. As previously explained for the large installation, this is again a closed cycle.

The pure shale is discharged by the apparatus fitted to the third trough, and is conducted to the shale

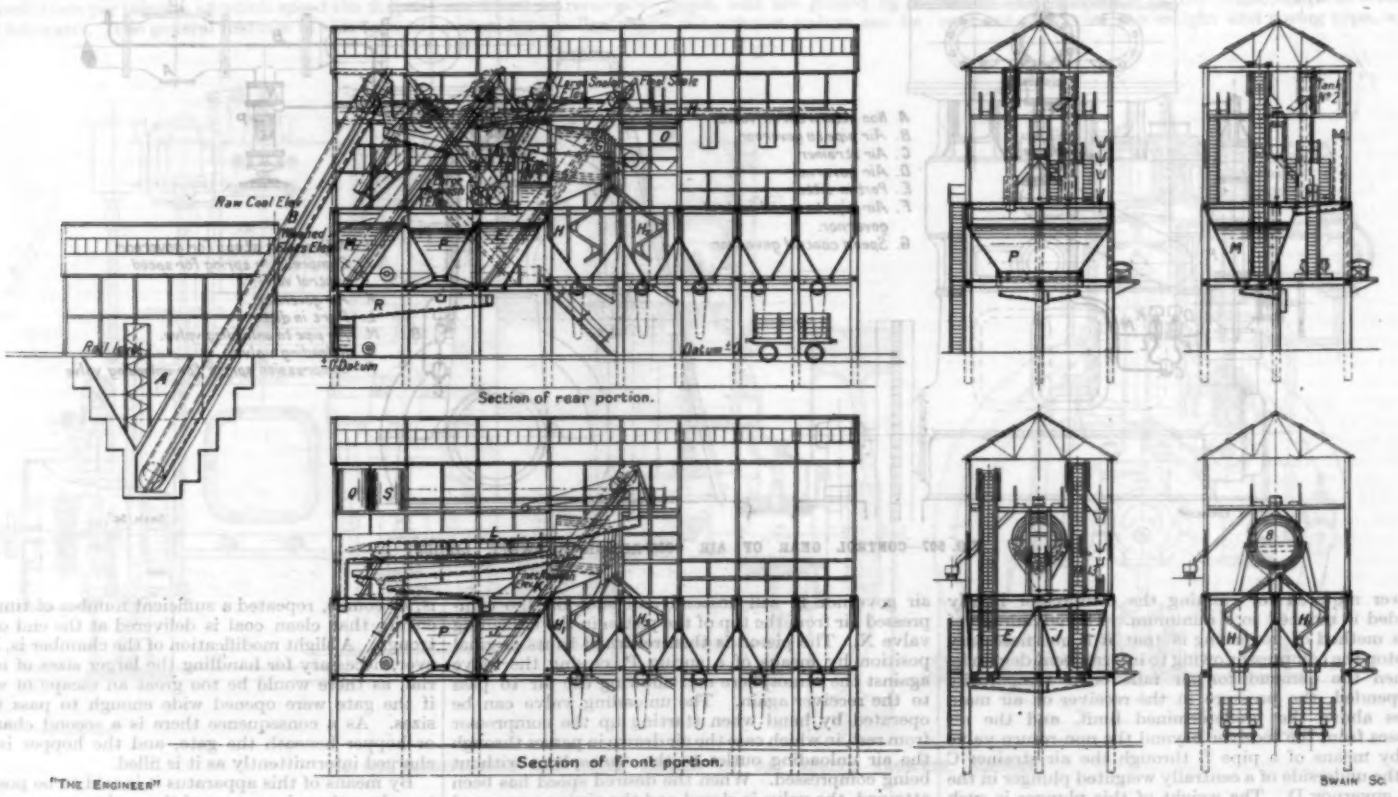


FIG. 509—COAL WASHING PLANT—BUTTERLEY

cistern E, then by means of the final shale elevator it is raised into shale hopper O, which is so arranged as to discharge the shale into pit tubs running on a gantry. The overflow from the reinforced concrete cisterns J, M, and E passes into the reinforced concrete settling tank P, where the sludge is allowed to settle. The clear water is raised by a pump to the overhead clear water tank Q, which is used to supply the washing installation. The sludge is discharged from the cisterns and settling tank continuously, and passes into the sludge channel R, which leads it to a sludge sump, and it is then pumped up to an overhead tank S and then to the head of the fines installation L for re-washing and mixing with the fine washed coal.

Vickers-Petters, Limited.

Among the numerous oil engines which are being shown at Wembley, one of the most extensive groups of such machinery is that which is to be seen on the stand of Vickers-Petters, Limited, of Ipswich. The exhibit referred to forms part of that very large stand which is devoted to the products of Vickers Limited, and its associated companies, and some of the engines are usefully employed in supplying the necessary current for electric lighting and power required on the stand. In addition to the engines, which may be seen running on load, there is also a very representative selection of stationary small engines, which are available for inspection.

The main lighting set comprises a four-cylinder Vickers-Petters unit, coupled to a 110-kilowatt Metropolitan-Vickers direct-current 220-volt generator, running at a speed of 300 revolutions per minute. The engine has a 12in. bore cylinder, with a stroke of 14in., and is designed for a normal working load of 168 brake horse-power and a maximum output of 180 horse-power. Running in parallel with this set there is a single-cylinder model of the cold starting engine for heavy fuel oil, which was brought out by the allied company of Petters Limited, Yeovil, last year, and which formed the subject of an article in our issue of June 22nd of 1923. It drives a 12-kilowatt dynamo, which works in parallel with the larger generator. The cooling water for both the engines is circulated through a Heenan and Froude type cooler, with electrically driven fan and water supply pumps. All the switchgear and wiring for the installation was carried out by Vickers Limited and its associated concerns. Both engines run exceptionally smoothly, and form an excellent example of modern low compression hot-bulb engine practice.

A third engine, which we illustrate by the accompanying engraving, Fig. 510, is of the marine type. It, also, is available for demonstration purposes and is connected to air-starting vessels, so that the process of reversing and manœuvring may be conveniently shown by running on air. This again is a four-cylinder unit, with 9in. bore cylinders and a 10in. stroke. At normal load and when running at a speed of 375 revolutions per minute, each cylinder is rated at an output of 23½ brake horse-power, but the engine, we learn, will work at a total output of 100 horse-power over long periods.

As will be seen from the drawing, Fig. 511, the engine is of the two-stroke cycle type, with crank case compression. A feature of all the Vickers-Petters models is the harmonious and pleasing outline of cylinder column which has now been adopted. The old system of taking the air required for combustion into the crank case through unsightly valve plate covers has been discarded in favour of a clean line of crank case. The crank case inspection doors are so constructed that a clear passage for air is formed by means of a port in the bed, so that the air is transferred from the bed-plate to the crank case all within the main casting. The bed-plate is substantially designed, and the main bearings are water-cooled. It may be noted that a thrust bearing of the Michell type is mounted at the after end of the bed-plate. At the forward end are the two bilge and circulating pumps, grouped on either side of the bed-plate. They are of the reciprocating type and are driven from the main crank shaft through reduction gearing. The makers claim that these slow-running positive-stroke pumps remove a difficulty which was paramount in the early days of marine oil engines. For

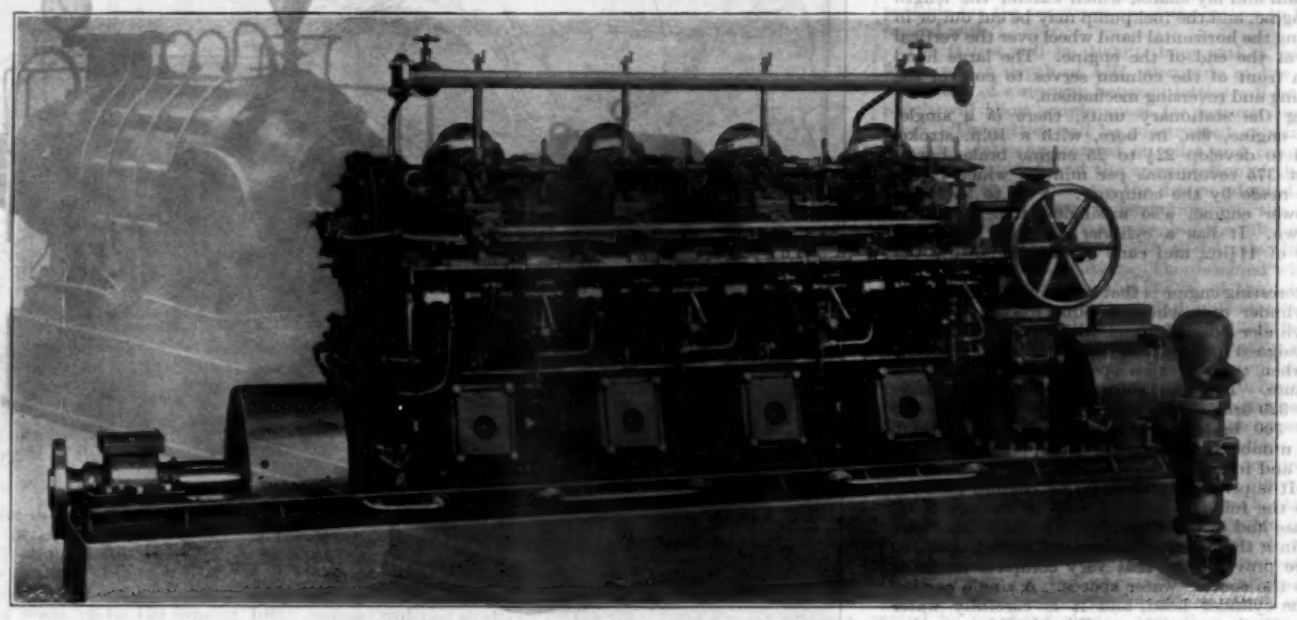


FIG. 510—FOUR-CYLINDER MARINE TYPE OIL ENGINE—VICKERS-PETTERS

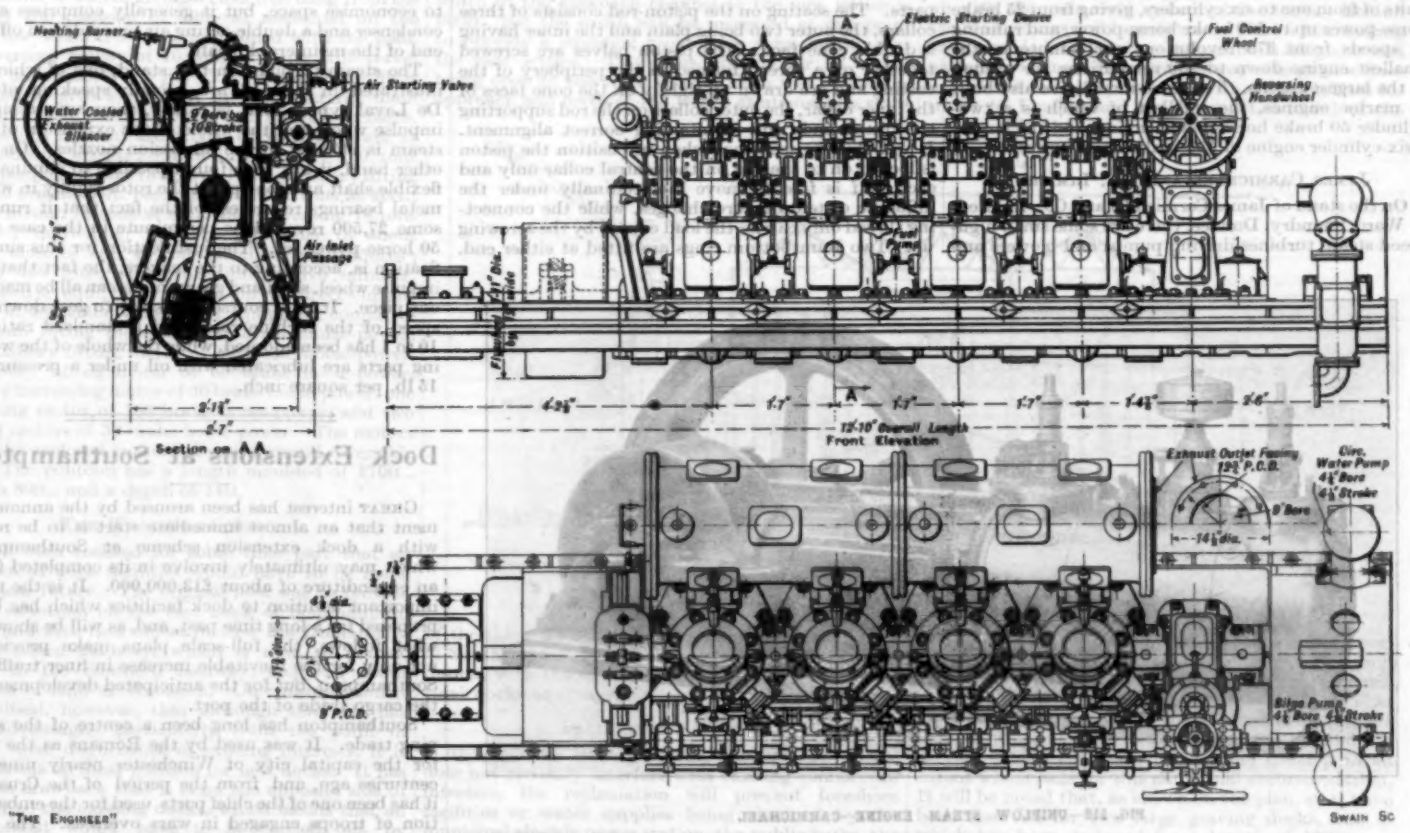


FIG. 511—FOUR-CYLINDER MARINE TYPE OIL ENGINE—VICKERS-PETTERS

starting, each cylinder is provided with a rapid heating burner, the flame of which impinges upon a plug of special alloy placed in the cylinder head. By using the heating lamps, the engine, we are informed, may be started in two minutes. Electric starting apparatus is also fitted to each cylinder. It consists of an electrically heated torch, which is caused to glow by external current supplied to it. Means are provided for withdrawing it from the cylinder space by a threaded sleeve when the engine has been started. When such apparatus is used the engine may, we learn, be started from cold immediately. It may be noted from Fig. 511 that each cylinder is complete with its own fuel pump and a compressed air starting valve. Each fuel pump is also fitted with the firm's patented slow-running device, by means of which the engine can be run dead slow for as long as may be required without having recourse to lighting up the heating burners.

The valves and fuel pump are operated by horizontal cam and lay shafts, which extend the length of the engine, and the fuel pump may be cut out or in by moving the horizontal hand wheel over the vertical column at the end of the engine. The large hand wheel in front of the column serves to control the air starting and reversing mechanism.

Among the stationary units, there is a single-cylinder engine, 9in. in bore, with a 10in. stroke, designed to develop 22½ to 25 engine brake horse-power at 375 revolutions per minute, which is the smallest made by the company. A 28 to 30 brake horse-power engine, also a single-cylinder unit, is also shown. It has a cylinder bore of 10½in. and a stroke of 11½in., and runs at 325 revolutions per minute.

An interesting engine is that representing the largest single-cylinder unit which is built by the firm. It has a cylinder bore of 16in., with a stroke of 18in., and is designed for a normal output of 80 brake horse-power when running at a speed of 250 revolutions per minute. The unit shown is part of the four-cylinder 320 brake horse-power engines, and the six-cylinder 500 brake horse-power engines, of which quite a number have now been supplied to power stations and industrial works in various parts of the world. It is perhaps in these larger engines that one notes to the full the graceful lines of the combined crank case and cylinder casing. The main liners are pressed into the cylinder casing and large inspection doors are provided, so that very complete access is given to the cooling water spaces. A single casting forms the cylinder head, and it is carefully water cooled on the lower portions. Considerable attention has, we understand, been given to the design of the exhaust and scavenge air ports, with the result that in all cases the engines are capable of giving a considerable overload over a prolonged period. This feature, combined with the ability to run light for indefinite periods without the use of any external heating, is characteristic of all sizes. Vickers-Petters engines of the stationary type are made in various units of from one to six cylinders, giving from 25 brake horse-power up to 500 brake horse-power, and running at speeds from 375 revolutions per minute in the smallest engine down to 250 revolutions per minute in the largest engine. The same models are also built as marine engines, the smallest of which is a two-cylinder 50 brake horse-power engine, and the largest a six-cylinder engine of 550 brake horse-power.

James Carmichael and Co., Limited.

On the stand of James Carmichael and Co., Limited, of Ward Foundry, Dundee, there are some small high-speed steam turbines driving pumps and blowers and

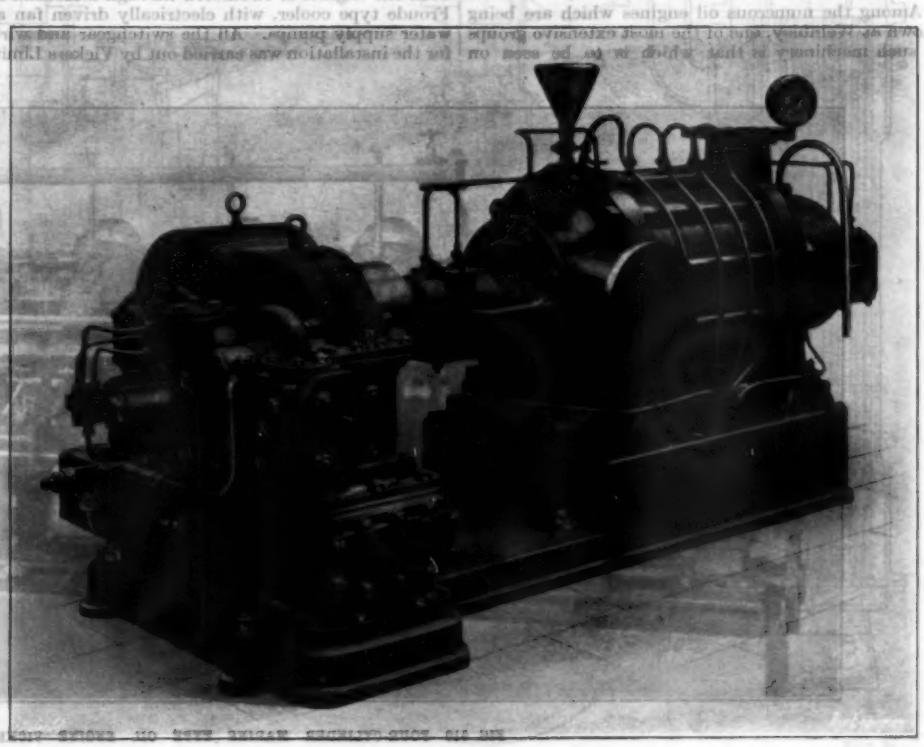


FIG. 513—GEARED TURBINE AND PUMP—CARMICHAEL

a uniflow steam engine, which is illustrated in Fig. 512.

This engine follows standard practice in general principles, but is noteworthy on account of the arrangements made for relieving excess compression pressures in the event of the vacuum at the exhaust being lost. Instead of relying on hand-operated valves for the purpose there is an auxiliary exhaust valve at each end of the cylinder which is entirely automatic in its action and relieves the attendant of all anxiety both when starting up the engine and when it is running. Another notable feature about the engine is the fact that all the governor gear is mounted either on ball or roller bearings, with the result that it responds very readily to changes in the load, and the governing is very sensitive. The cylinder is built up of three separate pieces, the central working barrel and two end sections, which contain the steam and relief valves, and are steam jacketed in order to reduce initial condensation. The steam inlets are, by the way, on the lower side of the cylinder. The valves are of the double-beat type, of iron, and the joints between valve cover, cylinder, &c., are made metal to metal.

In the small sizes of engine the piston is completely cylindrical and is divided circumferentially into two parts. The seating on the piston-rod consists of three collars, the outer two being plain and the inner having a double cone face. The piston halves are screwed together on a thread formed in the periphery of the casting and are drawn up tightly on the cone faces of the inner collar, the outer collars on the rod supporting the piston ends and maintaining correct alignment. It will thus be seen that when in position the piston is locked on to the rod on the central collar only and each half is free to move longitudinally under the influence of temperature changes, while the connecting thread only carries the load caused by the screwing up. Two Ramsbottom rings are fitted at either end.

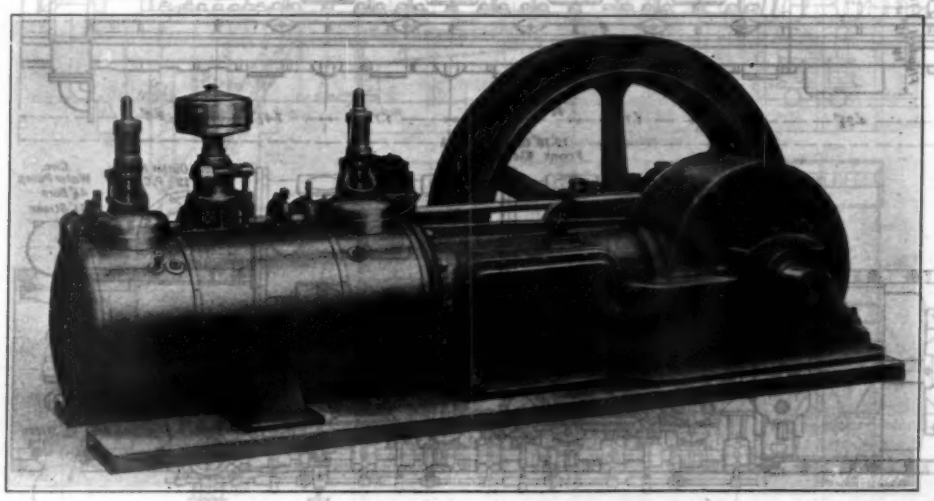


FIG. 512—UNIFLOW STEAM ENGINE—CARMICHAEL

The piston-rod is of high tensile steel and is fitted into the cast steel crosshead with a taper and cotter. Universal self-adjusting metallic packings are fitted in the stuffing-box and a light cast iron cover incorporating a swab box is provided to prevent carbonisation on the piston-rod.

An independent excentric on the lay shaft is employed for each valve, and the inside straps are extended to form a short excentric rod for driving a swinging link with a variable point of suspension. A driving rod runs from the valve bonnet cam to meet the excentric rod at approximately 90 deg., and its lower end consequently follows an elliptic path, the axial inclination of which is controlled by the swinging link. The length of time the steam valve is open varies with the inclination of the driving pin path, which in turn is determined by the governor acting on the swinging link suspension. The range of cut-off lies between zero and 25 per cent. of the piston stroke, and a constant point of steam admission is obtained throughout the complete range.

In the case of the engine exhibited, which develops 115 brake horse-power when running at 180 revolutions per minute, and has a cylinder 15in. in bore by 18in. stroke, the condensing plant has been omitted to economise space, but it generally comprises a jet condenser and a double-acting air pump driven off the end of the main crank shaft.

The steam turbines on this stand, one of which is illustrated in Fig. 513, are, broadly speaking, of the De Laval type. That is to say, they have a single impulse wheel and the whole of the expansion of the steam is effected in the admission nozzles. On the other hand, it has been found possible to eliminate a flexible shaft and to support the rotor rigidly in white metal bearings regardless of the fact that it runs at some 27,500 revolutions per minute in the case of a 50 horse-power set. The justification for this simplification is, according to the makers, the fact that the impulse wheel, shaft and gear pinions can all be made in one piece. It is, of course, necessary to gear down the speed of the turbine rotor and a standard ratio of 10 to 1 has been adopted, while the whole of the working parts are lubricated with oil under a pressure of 15 lb. per square inch.

Dock Extensions at Southampton.

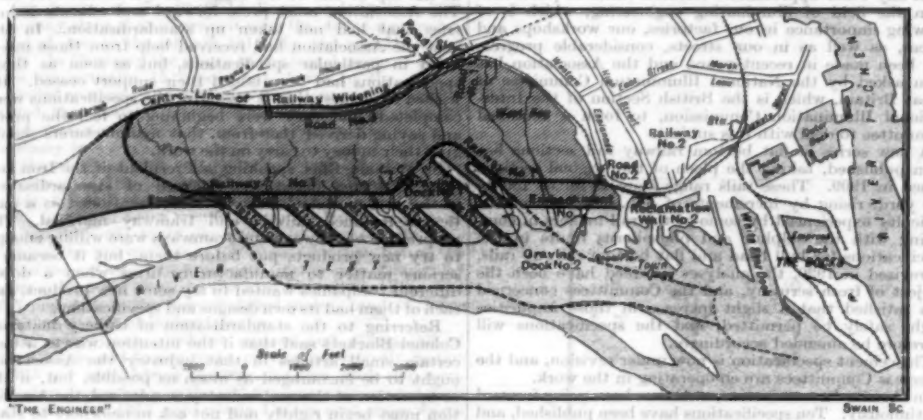
Great interest has been aroused by the announcement that an almost immediate start is to be made with a dock extension scheme at Southampton, which may ultimately involve in its completed form an expenditure of about £13,000,000. It is the most important addition to dock facilities which has been proposed for a long time past, and, as will be shown in what follows, the full-scale plans make provision, not only for the inevitable increase in liner traffic at Southampton, but for the anticipated development of the cargo trade of the port.

Southampton has long been a centre of the shipping trade. It was used by the Romans as the port for the capital city of Winchester nearly nineteen centuries ago, and from the period of the Crusades it has been one of the chief ports used for the embarkation of troops engaged in wars overseas. The first dock was constructed in 1843, and additional dock facilities were provided from time to time by the old Southampton Dock Company. The development of the port to a high status has, however, taken place since the acquisition of the dock estate by the London and South-Western Railway in the year 1892.

A brief description of the existing dock system may

be given. The Ocean or White Star Dock, of 16 acres, furnishes four deep-water berths for the large liners engaged in the Transatlantic trade, and an additional berth for the large ships has been provided adjacent to the Ocean Dock. The Empress Dock has a water area of 18½ acres and a depth of water of 26ft. at low water springs. Other accommodation includes the Outer Dock of 16 acres area with a depth of 18ft. at low water, the Inner Dock of 10 acres, with a depth of 26ft., the North Extension on the Itchen side, and the Itchen and Test quays, with depths up to 32ft. at low water.

There are six dry docks, ranging in length from 281ft. to 900ft. and in width from 51ft. to 100ft., as well as the 60,000-ton floating dock which has recently been added to the equipment of the port to provide dry-docking facilities for the Majestic and Leviathan, which could not be accommodated in the Trafalgar Dock, the largest of the old graving docks.



the construction of the embankment, the reclamation, and the construction of two of the jetties, which will provide four additional deep-water berths for large liners, and will, it is believed, meet the requirements of the immediate future.

The works, for which parliamentary powers were obtained this session, the Bill receiving the Royal Assent in August last, will be carried out to the designs of Mr. F. E. Wentworth-Sheilds, M. Inst. C.E., the Docks Engineer of the Southern Railway, who has been associated with all the developments of the dock system at Southampton since it was acquired by the old London and South-Western Railway. With the object of embodying the latest ideas in mechanical handling plant for the new dock works Mr. G. R. Newcombe, the Assistant Docks Manager, Mr. E. F. Bone, Commercial Assistant, and Mr. M. G. J. McHaffie, of the Dock Engineer's Department, have visited Bremen, Bremerhaven and Hamburg, and will probably pay a visit of inspection at a later date to other continental ports.

The scheme reflects great credit upon the enterprise and foresight of the Southern Railway. The citizens of Southampton, who are co-operating with the company in every way, appreciate the energetic manner in which Sir Herbert Walker, the General Manager of the Southern Railway, and Major G. S. Szlumper, the Docks Manager, have promoted this fine project. The construction of the first section of the works will occupy a period of five years.

British Engineering Standards Association.

THE sixth annual general meeting of the British Engineering Standards Association was held at the Institution of Mechanical Engineers on Friday, October 17th. The chairman, Sir Archibald Denny, occupied the chair, and presented a statement on the work of the Association during the past year. He noted that the contributions and sales had met the expenses within about £200—the auditors' balance sheet shows a deficiency for the year of £199 2s. 8d. Unfortunately, a deficiency of £1700 is inherited from the preceding year, so that the total debt of the Association is £1900, which, it is hoped, may be gradually paid off. The Main Committee has during the past year given the question of finance its most serious consideration, and as a result it appointed, early in the year, a Committee of Ways and Means, consisting of a number of gentlemen eminent in the various trade organisations, and through long connection with the details of its work, fully conversant with the requirements of the Association. The chairman was happy to say that as a result of the work of this Committee there were indications that the necessary extra funds to enable the Association to carry out its work adequately and efficiently would be forthcoming. Large numbers of people, he added, were already converted to the idea of national simplification, and he hoped that through the efforts of the Ways and Means Committee the Association would eventually secure the support of a far larger number of firms in this country than it had done up to that time. The Association had spent nearly £15,280 during the year, to which industry had contributed just over £8900. Government grants, including those from the Air Ministry and the War Office, amounted, according to the balance sheet, to approximately £3700, but Sir Archibald Denny said he could not "too strongly urge H.M. Treasury to consider the advisability of increasing their financial support towards the overhead charges of this movement, which unostentatiously perhaps but none the less certainly, is contributing so largely towards national economy."

The sales of publications showed an increase during the year, when the number reached 47,890, as against 42,424 in the preceding year. In addition, 28,760 Aircraft specifications were distributed for the Air Ministry. The number of Committees is now 442, and the membership 2166.

After these general remarks upon the position of the Association, the chairman gave some account of the principal work undertaken during the year.

The chief point of interest was the official representation on the Main Committee of the Automobile Industry through the Institution of Automobile Engineers. The automobile industry is greatly in need of simplification and standardisation, and through the Society of Motor Manufacturers and Traders, which has appointed a Standardising Committee, the standards should be more easily put into practical application than in almost any other branch of industry. Ten specifications applicable to automobile work were issued up to March 31st, 1924, the end of the financial year, and since that date twelve more, making twenty-two in all since the last annual meeting.

At the request of the Mining Association of Great Britain, a sectional Committee on Colliery Requisites was constituted. This Committee has the full support, both moral and financial, of the Mining Association; consequently, its recommendations should be put into operation without difficulty throughout the collieries of the country. In order that local conditions and practice may have the fullest consideration in all the deliberations of the Committee, a number of Regional Committees in the principal coalfields have been set up, and meetings have already been held by most of them.

In the field of mechanical engineering, which, unlike other countries, we have not explored to any extent, the Association has carried out two notable pieces of work, one dealing with the question of limits for engineering work generally, and the other with nuts and bolts. The great controversy which surrounded the question of limits, has been settled on lines which it is hoped will prove satisfactory to the country as a whole. The industrial world is evidently tending towards what is known as the Unilateral system in the distribution of the tolerances, and the Association has decided to recommend that system to industry. Yet, in order that it may in no way coerce or be used to coerce any branch of industry, the recommendation has been safeguarded by stating that the Unilateral system as applied to cylindrical mating surfaces is recommended in all cases where it does not conflict with predominating present practice.

A revised report for parallel keys and keyways for shafts from ¼in. to 12in. has now been completed and published, and the question of taper keys and splines is under consideration. A thoroughly representative committee has also been set up to deal with the question of cast iron generally.

One of the most important pieces of work carried out successfully is the completion of the revised booklet on steel sections, which gives for all standard sections not only the dimensions, but also the moments of inertia and other geometrical properties for the convenience of designers. A series of approximate formulæ has been added for computing the values of the intermediate sizes of the standards having web thicknesses other than those given in the lists or sections of similar proportions to the standard. These formulæ are believed to be more exact than any other approximate formulæ hitherto published.

In the field of illuminating engineering, which is of growing importance in our factories, our workshops and offices, as well as in our streets, considerable progress has been made in recent years, and the Association has been asked by the National Illumination Committee of Great Britain, which is the British Section of the International Illumination Commission, to form a Sectional Committee to deal with this subject.

A new series of flat bottom railway rail sections has been published, taking the place of the original sections issued in 1909. These rails range from 24 lb. to 100 lb. per yard, rising by increments of 5 lb. In view of the difficulty experienced by some of the rail makers in complying with the sulphur and phosphorus limits in the specifications for bull head and flat bottom railway rails, as revised in 1920, the analyses specified have been the subject of fresh scrutiny, and the Committees concerned was satisfied that a slight increase in those impurities might safely be permitted, and the specifications will therefore be amended accordingly.

The cement specification is now under revision, and the Overseas Committees are co-operating in the work.

In the non-ferrous section, work has been going forward continuously. Ten specifications have been published, and thirty-eight are in draft form. A new section of the Association's work, viz., that dealing with paints and varnishes, was begun as a result of a request from the National Federation of Associated Paint, Colour and Varnish Manufacturers. Work in regard to the details of ships and their machinery is going forward.

In the petroleum section, it has been decided that the specification for motor and aviation spirit shall stand without revision for a further period of twelve months. In the aircraft section the thirty wrought steel specifications are under review, and there will be a welcome reduction in their number. The Electrical Sectional Committee, which is the British National Committee of the International Electro-technical Commission—the I.E.C.—has been active in many directions. Nineteen specifications have been issued.

An important section of the chairman's statement dealt with the United States of America, where every branch of industry is being repeatedly urged to standardise on a national basis, so that they may increase production and reduce costs and waste. "To carry this work even further into practical politics, plans are being laid to draw into closer relationship the countries composing the Pan-American Union and so establish American standards throughout South America. A preliminary conference, consisting of business men, manufacturers, and even bankers, met in Boston in June last at the request of the American Engineering Standards Committee, who were asked, be it noted, to call this conference by the Inter-American High Commission of the United States Department of Commerce, the reason being to enable American industries to make arrangements for participation in an official Pan-American Conference on Standardisation to be held in Lima, Peru, at the close of the year. The intention apparently is to promote technical standardisation, including nomenclature, specifications, methods of test, for machinery and manufactured products generally. This great campaign of standardisation which is going on in America will inevitably have serious results on our own trade unless we take it in the right spirit and do our utmost in our own field. It is in this connection that the Overseas Committees of the Association can render the manufacturers of this country invaluable assistance, as from their intimate knowledge of local conditions they are enabled to give advice which is obtainable in no other way."

Sir Archibald referred lastly to the recently appointed Government Co-ordinating Committee on Government Stores, with which the Association is intimately connected. The movement to co-ordinate the requirements of the Government Departments in technical and non-technical requisites is a very important one. The Association has been placed entirely at the disposal of the Committee to give it every information possible, and the secretary attends the Committee's meetings for this purpose. The advantage of this close co-operation will be evident, seeing that it is the desire of the Government Inter-departmental Committee to bring its requirements as far as possible into line with best industrial practice.

"The main purpose governing the work of this Inter-departmental Committee, which is co-ordinating the stores common to the three services, is that wherever possible they will adopt trade standards or patterns, and at the same time they will co-ordinate methods of test and procedure in their inspection work. Of course, a considerable amount of their work will be of a non-technical nature, which will not touch the work of the Association. On the other hand, the work of the Association touches so many branches of industry that the experience of the Association will again be of material assistance to the Government in this important work."

After the presentation of this statement the chairman invited comments or suggestions from the meeting. Mr. H. J. Skelton moved the adoption of the report. In doing so he urged upon the Association the necessity of doing more propaganda work. In view of what had already been done he was convinced that other work which it might undertake would bring in a return far in excess of an expenditure of £1000 or so per year if industry would provide that sum. He mentioned particularly the need of publishing more specifications in foreign languages.

Mr. Bremner seconded the motion. He regretted that the Association had received inadequate financial support, and promised that the British Engineers' Association would do all in its power to encourage its members to come to its help. He agreed with Mr. Skelton that more propaganda was needed.

Mr. Llewellyn Atkinson refused to take a despondent view of the financial position. He estimated that during its existence the Association had spent about £150,000, and so far it was only about 1 per cent. on the wrong side. Speaking as acting chairman of the Ways and Means Committee, he said that a great deal of the ground had been explored, and certain conclusions had been reached. Referring to the general conditions of industry, he invited the meeting to observe that nearly all the depressed industries were those which had not attacked the problem of standardisation. The electrical industry had been in the van of that movement, and it was now at the top of one of the biggest booms it had ever had. The Association must press forward and educate industries that had not taken up standardisation. In the past the Association had received help from those interested in particular specifications, but as soon as those specifications had been issued their support ceased. He wished to suggest that it was after the specifications were completed, and they were beginning to feel the profit and saving derived therefrom, that manufacturers should give their money to carry on the work.

Sir William Ellis, speaking as President of the Iron and Steel Institute, urged the increase of standardisation in the iron and steel industry. He mentioned as a particular instance railway and tramway material. The proprietors of railways and tramways were willing enough to try new products put before them, but it became a serious matter to manufacturing firms when a dozen different companies wanted to try some new product, and each of them had its own designs and specifications.

Referring to the standardisation of colliery material, Colonel Blackett said that if the intention was to attack certain small articles in that industry the Association ought to be encouraged as much as possible, but, if the co-operation of the coal industry was desired, the Association must begin rightly and not ask mineowners to standardise things which it would be foolish of them to attempt. He suggested that one of the first problems to attack should be the steel used for wire ropes.

The secretary, Mr. Le Maistre, replying specifically to Colonel Blackett, and referring to his own recent lectures to the Coal Association and Mining Engineers, said that it was up to the coal industry itself to carry out the standardisation and put its own house in order. The coal industry knew far better than the Association what ought to be done in the way of standardisation.

The motion was then carried unanimously, and after Sir Archibald Denny had replied, the meeting came to an end.

Cost of Production.

By E. T. GOOD.

THE chief point in the problem of trade is that of economical production. On this vital point British industry is in some cases being beaten. The following are the leading facts.

Beginning with coal, we have a British pit-labour cost of just about 13s. per ton. It was 12s. before the last advance. Against that, the American cost is about 8s., and the German cost barely 6s. The very low German cost is due chiefly to the fact that living costs are easy. Germany has a wonderfully scientific agriculture. As recently recorded in our *Board of Trade Journal*, German food prices are very nearly back to pre-war level. Cereals and potatoes are much cheaper than before the war. Not only so, but luxuries, such as beer and tobacco, are far cheaper in Germany than here. Rents are not a cent beyond the pre-war level. Furthermore, the German miners have accepted wages below the pre-war rates, and they are working the pre-war hours. It was recorded in our *Ministry of Labour Gazette* for March, on the authority of the German Federal Statistical Office, that the wages of German unskilled mine workers were only 6.5 per cent. above pre-war, and that the wages of the skilled miners were 16.6 per cent. under the pre-war level.

The hours of labour in German mining are ten a day above and below ground at the lignite, or brown, coal mines; eight and a-half hours a day below ground in Upper Silesia; eight hours below ground in the other districts; eight hours on the surface in Lower Silesia; and ten hours above ground in the other black coal districts. All men may work two hours a day overtime at the discretion of the employers, after consultation with the works council. One of our Commercial Secretaries in Germany reported a few months ago that the coal output was just about back at the pre-war record, and was in some cases exceeding that record.

The American figure of 8s. per ton is based on returns from the United States for the first quarter of 1921, with an allowance added for the wage advance secured by the miners in 1922. This low labour cost of 8s. per ton, compared with our 13s., is due to the high American output per man. Since the war the United States production per man-week has almost touched 20 tons, against our output of little more than 4 tons per man-week since the Armistice. Even last year, with no mining strikes of importance, and with improved working compared with 1919-22, our output per man-week hardly reached 5 tons. The net result is that American coal is being sold to-day at an inclusive pithead price of 1½ dollar per ton, which is less than our cost for direct labour alone.

The high British cost is due to low output. So long as it takes over 1,000,000 miners to produce less than 5,500,000 tons per week, we shall be in this unfortunate position, namely, if we pay the miners well our coal will be dear, whilst if we have anything like reasonably cheap coal we must "sweat" the miners. Forty years ago we had 6 tons of coal per man employed at the mines per week. Since the war, with greatly improved mechanical appliances, we have only had 4 tons per man-week. Since

1913 we have doubled the number of our coal cutters; we have trebled the number of our mechanical conveyors; we have increased the number of our miners more than 5 per cent.; yet our output per man-shift to-day is 20 per cent. less than in 1913. This seriously reduced output is the root cause of most of our economic troubles.

In iron and steel it is much the same. Wages in America average £7 a week, against our £3, to give round figures. The £7 is taken from the last annual report of the United States Steel Corporation, whilst the returns from the British iron and steel industry, as given in the *Bulletin* of the Manufacturers' Federation, showed wages to average £3 4s. for last March. But the output per man is three times as high in America as in Britain. Figures presented last year to the West of Scotland Iron and Steel Institute showed that whilst our nominal wage rates per man were 65 per cent. above the pre-war level, the wage cost per ton of pig iron was up by 143 per cent. The inflation was due to shorter shifts, more overtime rates, and generally easier working.

The books of the Sheffield Forge and Rolling Mills Company show that whereas it cost 19s. 4d. to manipulate a ton of steel in the mills in 1914, the cost was 51s. 1d. in 1923. In Germany the wages in the metal group of industries are actually 15.7 per cent. lower in the case of unskilled workers, and 29.9 per cent. lower in the case of skilled, than before the war. This also is on the authority of the Statistical Office, the returns being for the month of February last.

Take textiles. Our cotton trade wages advanced from an average of 19s. 7d. per person per week before the war to 34s. 8d. last year. That was an advance of 76.7 per cent., in return for a smaller output. Hours have been reduced from 55½ to 48 per week. In Germany they are working the pre-war hours for wages less than before the war to the extent of 13.5 per cent. in the case of unskilled males; 13.6 per cent. in the case of unskilled females; 24.7 per cent. in the case of skilled males; and 22.2 per cent. in the case of skilled females.

Our railwaymen, dockers, carters and others, all of whose wages add to our costs, may conservatively be put at 125 per cent. above pre-war, for less work per man. British railways have in the last five years, compared with the standard of 1913, paid nearly 150 per cent. more wages per man; they have employed 75,000 more men; they have carried 100,000,000 tons less traffic per year; they have paid very nearly 200 per cent. more wages per unit of work performed. Need we wonder at loss of trade?

Electric Lighting in a Drawing-office.

In no part of an engineering works is good lighting more essential than in the drawing-office, where the plans for the subsequent work are prepared. Not only must the intensity of the lighting be adequate, but glare and harsh shadows must be avoided. Glare is the defect which is most difficult to avoid when the intensity is raised to the value which is necessary for easy and efficient working, but there is really no reason why high intensities should produce glare.

Drawing-offices may appear overlighted, and the draughtsman may suffer eye strain. When, however, comparisons are made between the actual foot-candles obtained from the artificial source of lighting on the working plane and the average daylight intensity usually existing, it may be found that the artificial light intensity is not .01 per cent. of the daylight intensity, even if there be no sunlight in the room. The eye strain in this case is attributable to the glare of the artificial sources of light, and is caused by placing inefficient diffusing units too near the working plane. With brilliant patches near the worker and spaces of semi-darkness between tables and boards, the eye has constantly to adjust itself, and the workers suffer eye strain fatigue and general depression. But if properly spaced and properly designed diffusing units are employed, an even intensity of light can be obtained over the whole area, and eye strain is eliminated.

Experience has shown that in drawing-offices, above all places, an adequate quantity of soft and well-diffused light must be provided if discomfort is to be avoided. There should be no extreme contrasts in the brightness of objects within the field of vision, and shadows should be soft and luminous or entirely absent. Moreover, the lighting system should be designed to allow flexibility in the arrangement of the drawing-office equipment, and should be easy to maintain, otherwise a decreased efficiency may result.

In the design of the lighting equipment for the drawing-office shown in Figs. 1 and 2, all the above factors were taken into account. As shown in the plan—Fig. 3—the building is L-shaped, the dimensions being 92ft. long by 37ft. to 56ft. wide. It will be noted that the windows from which daylight is obtained are all on one side of the office, and the desks situated at the extreme distance from the windows are very inefficiently lighted during the hours of daylight, thus necessitating the assistance of artificial light. The lighting installation is composed of thirty-eight lighting units of the "Industria" type, especially designed by the Illuminating Engineering Department of the General Electric Company.

LOCATION	ILLUMINATION IN F.C.S.	HEIGHT OF W. PLANE ABOVE FLOOR LEVEL	LOCATION	ILLUMINATION IN F.C.S.	HEIGHT OF W. PLANE ABOVE FLOOR LEVEL	LOCATION	ILLUMINATION IN F.C.S.	HEIGHT OF W. PLANE ABOVE FLOOR LEVEL
A	17	2-6"	I	21	2-6"	V	26	2-6"
B	24	2-6"	K	24	2-6"	W	21	2-6"
C	25	2-6"	L	24	2-6"	X	23	2-6"
D	28	2-6"	M	24	2-6"	Y	21	2-6"
E	22	2-6"	N	23	2-6"	Z	24	2-6"
F	7	2-6"	P	21	2-6"	a	14	2-6"
F	7	2-6"	Q	14	2-6"	β	21	2-6"
G	16	2-6"	R	16	2-6"	γ	21	2-6"
H	28	2-6"	S	21	2-6"			
H'	19	2-6"	T	20	2-6"			
H	12	2-6"	U	28	2-6"			

ALL READINGS TAKEN ON WORKING PLANE

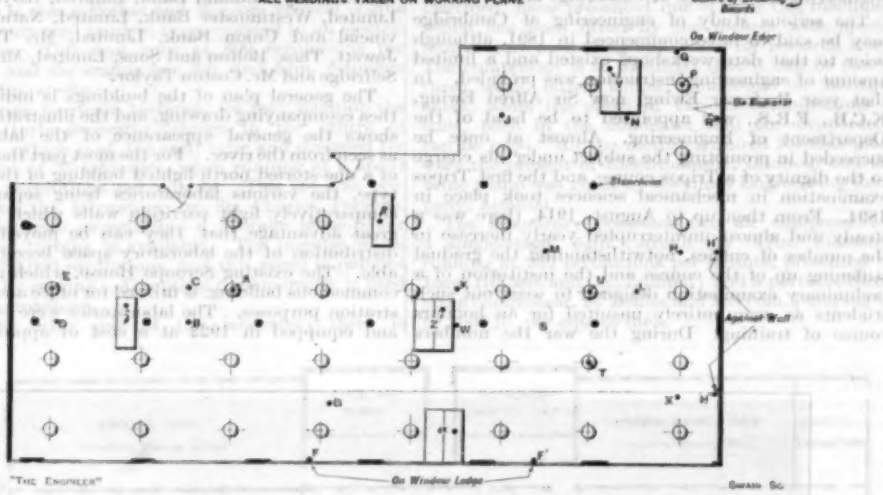


FIG. 3 PLAN OF DRAWING-OFFICE AND POSITIONS OF LIGHTS

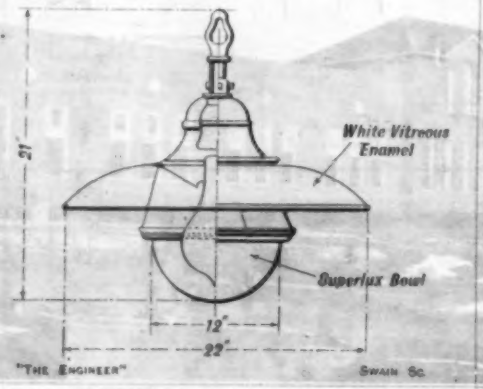


FIG. 4—ARRANGEMENT OF "INDUSTRIA" TYPE LAMP

Each unit—see Fig. 4—has a housing composed of white enamelled steel, with a vitreous white enamelled steel reflector, designed to meet drawing-office requirements, the light being diffused by the maker's well-known "Superlux" diffusing bowl. Each unit is capable of accommodating a 1500-watt "Osram" gas-filled lamp, but in this particular case 500-watt lamps are employed. These units are mounted at a height of 8ft. 6in. above the working plane, which is 3ft. above the floor. The spacing of the units is 9ft. 3in. by 12ft. When all the lighting units are in operation, the energy consumption is 19 kilowatts, and as the total floor area is 4136 square feet, the energy consumption per square foot of floor area is 4.6 watts, the watts per superficial foot per candle-power being 0.208. It was estimated, when the installation was designed, that an average illumination of 20 foot-candles would be obtained, and tests carried out after the work had been completed showed that the average intensity was 22.1 foot-candles.

The total cost of the electrical energy consumed amounts to only 0.7 per cent. of the salaries paid to those employed in the drawing-office, and if only 2½ minutes are saved per day by each of the men employed in the office, the total cost of the extra current consumption, as compared with that of the original lighting installation, which gave approximately one-fifth of the present intensity, will be more than covered. As visual activity increases with higher light intensities, it was estimated that more than the 2½ minutes per day would be saved, and it has since been definitely established by the administrative staff of the office that the saving per day is much more than twice the cost of the energy which is consumed. The plan—Fig. 3—shows the positions of the lighting units and the illumination intensities in different parts of the building.

FIGS. 1 AND 2 VIEWS IN A DRAWING-OFFICE ILLUMINATED WITH "INDUSTRIA" TYPE INCANDESCENT GAS LAMPS

Speaking at Glasgow recently, Mr. James Affleck, the new president of the Scottish Branch of the Institute of British Foundrymen, said that certain schemes were now on foot, supported by national funds, for the supply of electricity in bulk to various districts, and these schemes, if carried out, would, in his opinion, produce an almost revolutionary effect on industry. There would almost certainly be a greatly extended use of electricity in foundry practice, particularly for melting operations. At the present stage of development the greatest benefits would probably be gained in steel and brass foundries, through the use of electric furnaces. The great advantage of electricity in steel melting was generally recognised, but the advantages and possibilities of this method had not been appreciated to the same extent by brass and iron founders. In many brass foundries, including even large establishments, the melting methods were still in the mediæval stage, and the ordinary pot furnace reigned supreme.

Engineering Education at Cambridge University.

The Engineering Department of the University of Cambridge has now attained a leading and distinguished position among the engineering schools of Great Britain, and the purpose of the present article is to give—we believe for the first time—a connected account of the use and development of engineering teaching in the University—to describe the accommodation and equipment of the laboratories, and to make mention of some of the results which have been striven for and which, to a large extent, have now been gained. In a Special Supplement which accompanies to-day's issue, various views of the engineering laboratories at Cambridge are given.

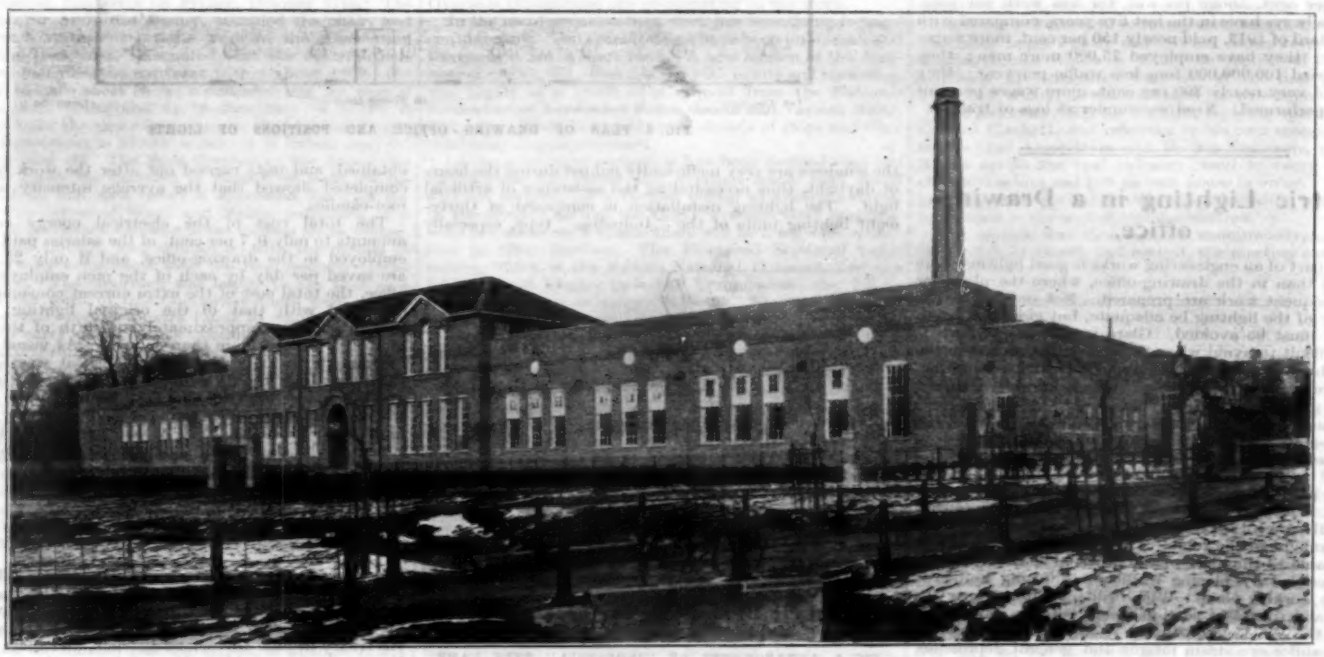
The serious study of engineering at Cambridge may be said to have commenced in 1891, although prior to that date workshops existed and a limited amount of engineering instruction was provided. In that year Professor Ewing, now Sir Alfred Ewing, K.C.B., F.R.S., was appointed to be head of the Department of Engineering. Almost at once he succeeded in promoting the subject under his charge to the dignity of a Tripos course, and the first Tripos examination in mechanical sciences took place in 1894. From then up to August, 1914, there was a steady and almost uninterrupted yearly increase in the number of entries, notwithstanding the gradual stiffening up of the course and the institution of a preliminary examination designed to weed out such students as were entirely unsuited for an honours course of training. During the war the numbers diminished almost to zero, as, for instance, in 1917, when only one student graduated with honours, and he was an Oriental. All the younger members of the teaching staff having left Cambridge a few seniors succeeded in developing the workshops into a small but useful munition factory, and generally maintained the organisation so that it was ready to deal with the renewed flow of students which began to pour in immediately after the Armistice and soon reached a mark greatly in excess of all pre-war levels. In 1920 the total reached the unwieldy number of 808. This congestion corresponded to the crest of a wave consequent on the breaking down of the barrier which had held up engineering education during the war period. This wave has now subsided, but it has left the total number at a much higher level than the pre-war figure, and there are indications that this total number will become stabilised at about 500, which is approximately the present figure.

Accommodation.

The original buildings consisted of those formerly occupied by the Perse Grammar School, and as the number of students steadily increased additional accommodation was provided from time to time, principally by means of private benefactions. The most important of these was the gift of the Hopkinson Wing in memory of Dr. John Hopkinson, F.R.S. In 1914, when the students numbered 270, the question of new premises had come prominently into view, and the late Professor Bertram Hopkinson was quite definitely of the opinion that the steadily increasing flow of engineering students could only be dealt with by transferring the Department of Engineering bodily to some neighbouring site, which would allow of free expansion, and erecting thereon a new engineering laboratory commensurate with the importance the subject had then attained as a course of study in the University. After the war the provision of new accommodation ceased to be merely urgent and became a matter of sheer necessity. The University was fortunate in being able to acquire the Scroope House site in Trumpington-street, and on that site, which extends over an area of about 4 acres, the construction of the new Department of Engineering was begun in the summer of 1920. The University itself contributed as far as its finances permitted towards the construction of these new engineering laboratories. Sir Dorabji Tata made a munificent contribution of £25,000, and other contributions were forthcoming from Sir Charles Parsons, Anonymous, the Hon. Clive Pearson, Mr. Michael Dewar, Barclays Bank, Limited, Sir Basil Zaharoff, Mr. H. G. Tetley, Midland Bank, Limited, Lloyds Bank, Limited, Westminster Bank, Limited, National Provincial and Union Bank, Limited, Mr. Thompson Jowett, Thos. Bolton and Sons, Limited, Mr. Gordon Selfridge and Mr. Coston Taylor.

The general plan of the buildings is indicated by thea ccompanying drawing, and the illustration below shows the general appearance of the laboratories as seen from the river. For the most part they consist of a one-storied north-lighted building of the factory type, the various laboratories being separated by comparatively light partition walls which have the great advantage that they can be moved if a redistribution of the laboratory space becomes desirable. The existing Scroope House, which is a large commodious building, is utilised for office and administration purposes. The laboratories were completed and equipped in 1922 at a cost of approximately £100,000, but no money was available for the construction of the two-storied lecture room block which forms part of the lay-out shown in dotted lines on the plan. For the time being the lecture rooms in the old Engineering Department have to be retained, and the waste of time consequent on having the lecture rooms and laboratories separated by a considerable distance constitutes an inconvenience which the authorities sincerely hope may before long be rectified by some generous benefactor who is interested in promoting the welfare of engineering education in this country.

To make the Department of Engineering self-contained on its present excellent site a further sum of about £60,000 is required for the erection of the two-storied lecture room block.



NEW ENGINEERING BUILDING AT CAMBRIDGE UNIVERSITY

The Engineering Courses.

In former days it was sometimes argued that Cambridge, not being situated in an industrial district, was necessarily an unsuitable centre for a large engineering school. If Cambridge aimed at giving specialised courses in engineering there might be some force in that contention. Where specialisation in some particular branch is required it should, if possible, be received in the locality associated with that industry. Thus Sheffield University, situated in the midst of the steel district, is the natural place for the intensive study of steel. Glasgow University, in the centre of the shipbuilding industry, is geographically well qualified for the study of shipbuilding. Cambridge, on the other hand, is the great manufacturing centre for all forms of scientific knowledge, and hence if the Cambridge Engineering School is to advertise any form of specialisation it should make it well known that its particular form of specialisation is general knowledge.

With this object in view the honours course in engineering at Cambridge has always aimed at giving a wide general education on broad lines rather than an intensive training in any particular branch. Specialisation during the normal course is only permitted, to a limited extent, in the third year, and the tendency is to push this specialisation more and more into a post-graduate course and thereby obtain additional time for the average student to study and master thoroughly the many and ever-increasing fundamental principles which must form part of the mental equipment of any engineer who nowadays can claim to have a well trained mind. The water-tight compartment system of education whereby subjects are dealt with separately and in succession is likewise discouraged. The various subjects are all worked at simultaneously with a view to showing their inter-relation. In the first year's course the subjects are naturally treated in an elementary manner and a considerable portion of the teaching at this stage is directed towards working students up to a certain standard in mathematics and mechanics.

In the second year the theory appertaining to heat engines, electricity, structures, mechanisms, hydraulics, metallurgy, &c., is gone into more fully, and in the third year the courses of instruction are designed to interest students in the practical applications of the theories they have assimilated during their first and second year courses. In the third year, courses in engineering chemistry, industrial economics and geology are also provided. A two years' course of lectures is given by the professor of aeronautics for second and third year students who desire to study that subject. Aeronautics appears in the final Tripos examination as one of the advanced voluntary papers.

In the Tripos examination, by which a student graduates with honours, he is tested as to his knowledge over the whole range of subjects dealt with in his three years' course. An examination of this sort is a searching test which cannot be countered by any short preliminary process of cramming. A student who does well in this comprehensive examination is not at that stage a specialist in any one branch of engineering, but, on the other hand, his mental balance is such that he can launch forth with equal facility in any direction, and when he ultimately takes up some definite line of work his broader education and greater versatility will enable him in most cases to overtake and outdistance the man who has been a specialist from the start of his engineering education.

A limited number of students who have the time to spare spend a fourth year in the Department, mainly occupied on research, and for students of more than normal ability this is a course which is strongly to be recommended whenever circumstances render it possible.

Combinations of courses at Cambridge can always be arranged. Thus, for chemical engineers a combination of engineering and chemistry, for administration and business careers a combination of engineering and economics makes an excellent training, and a considerable number of students who have a special aptitude for mathematics take Part I. of the Mathematical Tripos before entering the Department of Engineering.

That the broad system of education explained above is appreciated, is shown by the steadily increasing

number of practical engineers who send their sons to Cambridge to undergo this training. It is noticeable, moreover, that the liberality of the course appeals to a wide range of students other than those who are destined for an engineering career in the strict technical sense. A considerable number of the students working in the Department at any one time are fitting themselves for business or administrative appointments, and many important commercial posts in this country and abroad are held by men who in the past were students at the engineering laboratory. Since the war a large number of officers from the Corps of Royal Engineers and the Royal Air Force have been sent to Cambridge to take courses in engineering, and it is proposed that in the near future all Royal Engineer officers after leaving Woolwich shall enter Cambridge for two years and take the honours course in engineering.

Collegiate Life and Teaching Staff.

The engineering students at Cambridge are distributed fairly evenly among the numerous colleges. Instead of being segregated, their college life brings them into intimate contact with other students who have different interests and ambitions. The interchange of ideas and the breadth of vision which results therefrom is perhaps one of the most valuable educational influences which Cambridge has to offer in the training of its engineering students. As might be expected from their numbers, engineering students figure prominently in the athletic activities of the University. For instance, last year half the crew of the University Boat was recruited from the Engineering Department, and incidentally the Stroke gained a First Class in the Tripos Examination.

The teaching staff at the Department officially recognised by the University consists of a Professor—Professor C. E. Inglis, M. Inst. C.E., M.I. Mech. E., was elected to the Chair of Engineering in March, 1919—a Reader, two University Lecturers, three University Demonstrators, a Superintendent of the workshops and a Superintendent of the drawing-office. In addition to these University appointments, the Department has collected a staff of about thirty lecturers and demonstrators. There is also a staff of thirty workshop instructors, assistants and laboratory attendants.

A student receives the greater part of his instruction at the Engineering Laboratory, but all the colleges have supervisors in Engineering who supplement the departmental teaching with private tuition. In particular, all the elementary first-year instruction in mathematics and mechanics is left to the colleges, as it is recognised that these subjects can best be dealt with in small classes. The college supervisors are drawn from the teaching staff at the laboratory, so that they remain in the closest possible contact with the pupils under their charge. The high level of the staff is demonstrated by the fact that fifteen of them are Fellows of Colleges. This tendency of colleges to award Fellowships in Engineering is a recent development. It indicates the importance attached to this subject by the University, and it has been a great help to the Department in securing an efficient teaching staff. In most cases these Fellowships have been awarded to men who have gained a thorough practical experience in the outside world of engineering, and the attraction of a Fellowship at Cambridge is such that by this means it becomes possible to induce real engineers of exceptional ability to take up a career of teaching and research in the University.

Laboratory Equipment.

In our Supplement of to-day views of the various laboratories are given.

The Heat Engine Laboratory.—This laboratory—shown in Figs. I. and II.—may be conveniently divided into the following groups:—Boiler house, steam plant, internal combustion engines, refrigerators, air compressors, &c. In the boiler house—which we show in Fig. I.—in addition to two Cornish boilers used for heating the laboratories, there are two Babcock and Wilcox boilers, used for supplying steam to the engines. One of these boilers is arranged for hand firing on coal or for running on oil fuel; the other is fitted with a chain grate and forced draught. The full steaming rates of these boilers are about 1500 lb. and 2500 lb. of steam per hour respectively, and both were presented to the Department by the makers through the good offices of Sir James Kemnal. The same firm has also presented an economiser and a "Diamond" soot blower for the larger boiler. Two feed pumps have been presented by Worthington-Simpson, Limited, and a third, a Weir pump, is also available. A small boiler of the locomotive type, by Davey, Paxman, completes the boiler equipment. A steam meter, presented to the Department by George Kent, Limited, measures the steam supply down the 4½in. main to the laboratory, and the Cambridge Instrument Company, Limited, has presented a Callendar temperature recorder and an automatic CO_2 recorder. The Department is indebted to Stewarts and Lloyds, Limited, for supplying and erecting all the steam and water piping which was required in the laboratory, while the lagging of the steam piping was the gift of Newell's Insulation Company, Limited. The electric motors for the chain grate boiler—shown in Fig. I.—are the gift of the British Thomson-Houston Company, Limited.

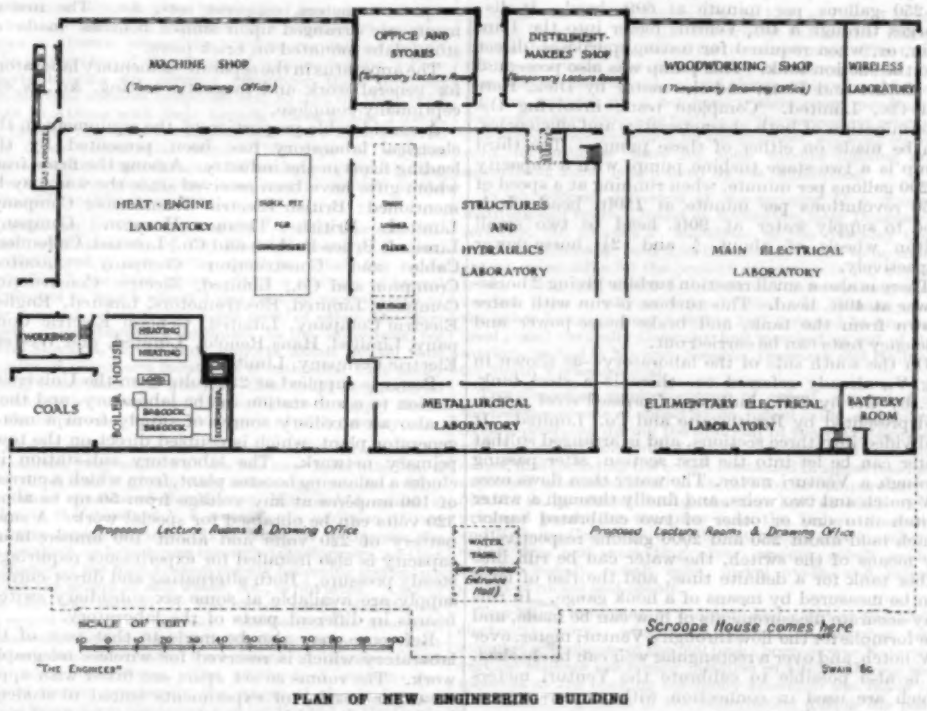
In the main laboratory—Fig. II.—the steam sets are grouped around a pit 5ft. 6in. deep, 49ft. 3in. in length and 19ft. wide. Inside this pit there are arranged the various condensers, air pumps and measuring apparatus. Among the steam engines which are available for testing, we may enumerate the following:—Robey uniflow engine, 14in. stroke by 12in. cylinder diameter, running at a speed of 185 revolutions per minute. The same firm has also supplied a horizontal tandem compound condensing engine, of 18in. stroke, with 8in. and 14½in. cylinders, designed for a speed of 120 revolutions per minute. Both these engines are fitted with mechanical brakes.

Another horizontal engine, also fitted with a mechanical brake, is fitted with Meyer expansion gear. It has a cylinder diameter of 8½in. and a stroke of 12in., and runs at a speed of 140 revolutions per minute.

There is also a Belliss and Morcom vertical engine of the compound tandem type, coupled to an electric generator. This unit runs at 600 revolutions per minute, and the engine has 3in. and 5½in. cylinders with a 4in. stroke.

Referring to steam turbines, we may mention the Parsons turbo-generator—shown in the centre of Fig. II.—which is of the early type and designed for an output of 35 kilowatts, when running at a speed of 5400 revolutions per minute. This set was presented to the laboratory by Sir Charles Parsons. For small-scale experiments a 5 brake horse-power De Laval turbine is available. The impulse wheel runs at 30,000 revolutions, and this speed is reduced to 3000 by gearing. An optical dynamometer is used with this machine.

On the other side of the laboratory there is



PLAN OF NEW ENGINEERING BUILDING

arranged a widely representative collection of internal combustion engines. The gas engines include a 7½in. bore by 9in. stroke Crossley; a 7½in. bore by 15in. stroke Hornsby; and a 7in. bore by 15in. stroke engine presented by the makers, the National Gas Engine Co., Ltd. These engines are designed for a speed of from 250 to 260 revolutions per minute, and provision is made for running either from the town mains or on producer gas. Mechanical brakes are fitted to all three engines. Notable among the oil engines in this department is a 50 brake horse-power Mirrlees Diesel oil engine, with a stroke of 18½in. and a cylinder 12in. in diameter. It is designed for a speed of 250 revolutions, and is connected to an electrical generator. The complete unit was presented to the laboratory by Sir Alfred Yarrow. Two other oil engines are one of the Hornsby type, with a 7in. cylinder and 13in. stroke, which drives an electric generator at a speed of 275 revolutions per minute, and a hot-bulb engine, presented by W. H. Allen, Sons and Co., Limited. This engine, which has a 9½in. cylinder and a stroke of 11in., is fitted with a Froude water brake and is designed for a speed of 375 revolutions per minute. Among the smaller motors, a four-cylinder petrol engine, presented by W. H. Dorman and Co., Limited, may be referred to. It is a 12 brake horse-power model running at a speed of 1000 revolutions per minute. A Ricardo variable compression engine, which is in the laboratory, has been lent by the Air Ministry for research work. It is complete with an electrical dynamometer. There is also a six-cylinder German submarine engine, by Benz, which was presented by the Admiralty. The engine is complete with its generator, and is designed for an output of about 550 brake horse-power, at a maximum speed of 450 revolutions per minute.

All the internal combustion engines are provided with exhaust calorimeters and other appliances, so that complete heat balance data can be worked out for each of them.

The refrigerating plant section includes three representative types of plants. There is a Linde NH_3 machine of about half a ton of ice per day capacity, which was presented by Mr. T. B. Lightfoot, and has recently been completely renovated by the Lightfoot Refrigeration Company, Limited. Another ammonia machine is that presented by L. Sterne and Co., Limited, of Glasgow. It has a refrigerating capacity of about 4 tons of ice per day, is complete with a condenser and evaporator of the concentric tube type, and it is driven by a variable-speed motor, presented by W. H. Allen, Sons and Co., Ltd. The brine pump belonging to this set was the gift of Drysdale and Co., Limited. J. and E. Hall and Co., Limited, of Dartford, have presented one of their CO_2 machines, which has been fitted by the makers with special temperature-measuring appliances for research work. The compressor is so arranged that it can be run in three ways, either simple, compound or multiple effect, while the effect of various combinations of coils, both in the condenser and the evaporator, can be tried. All the motors required for this plant were the present of Electromotors, Limited, and the brine pump was given by Gwynnes Engineering Company, Limited.

The laboratory possesses two air compressors—a single-stage, 5½in. stroke by 4½in. diameter, running at 250 revolutions per minute, presented by Lacy-Hulbert and Co., Limited; and a portable three-stage compressor, by Belliss and Morcom, pumping up to 2000 lb. per square inch.

A remaining section of the heat engine laboratory is devoted to experiments in physical-chemistry, and the equipment includes various calorimeters for fuels, and instruments for determining flash-point, viscosity, self-ignition point, &c., of oils. Closed explosion vessels of the Hopkinson type are provided to enable students to work on problems connected with gas explosions. The usual gas analysis apparatus of the Orsat and Hempel types is provided for the study of properties of flue, exhaust and producer gases.

The Testing of Materials and Structures.—This laboratory—illustrated by Figs. III. and IV. in the Supplement—is well equipped for making standard tests on materials of various kinds.

For tension, compression, bending and torsion tests the following machines are available:—One 50-ton and two 5-ton Buckton machines, one 10-ton and two 10,000 lb. Avery machines, besides two special torsion machines, which have been designed and made by the Department. There are also several 1-ton tensile testing machines and a large number of extensometers of various kinds for testing materials within the elastic limit. Experiments are also arranged for measuring the modulus of rigidity and Poisson's ratio. For hardness, impact and fatigue testing, the laboratory is equipped with two Brinell hardness testers, an Izod impact tester, and a high-frequency fatigue tester.

Apparatus is also arranged for measuring the slope and deflection of loaded beams. Most of the work is done on actual beams, and one arrangement allows rolled steel joists or girders up to some 20ft. in length to be used. The slope and deflection at various points can be measured and specially designed extensometers allow the magnitude of the strain in the flanges to be determined. For measuring the flow of metals

under compression and for other purposes a 150-ton hydraulic press, the gift of Chas. Roberts, Limited, has been installed.

There is also a complete cement-testing plant for the British standard specification tests, and a testing machine for 3in. diameter concrete specimens in tension. The hydraulic press, referred to above, has been arranged for testing concrete cylinders, 2ft. diameter by 4ft. long in compression. In the illustration referred to the machine is being used to test some large concrete columns, made of materials which are to be used in the construction of the Sennar Dam.

Students undergo a full course of instruction in testing of materials, and also in the testing of joints and fastenings, including specially arranged experiments on the strength of riveted joints.

The Hydraulic Laboratory.—Outside the main building there is a 20,000-gallon water tank, raised some 40ft. above the floor level. From this tank to the laboratory runs a 12in. pipe, from which water can be drawn or pumped up to the overhead tank. Below the floor of the laboratory, extending for nearly its full length, is a suction tank, into which all the water is discharged. A view of this section of the laboratory is reproduced in Fig. V.

There are three electrically driven centrifugal pumps. The first has a capacity at a speed of 1450 revolutions of 1000 gallons per minute at 50ft. head, and discharges through an 8in. Venturi meter into the 12in. main. This pump and motor were presented by Mather and Platt, Limited, the switchgear by Brookhirst Switchgear, Limited, and the Venturi meter and recording apparatus by George Kent, Limited. The second pump is a single-stage turbine pump, with a capacity, at 1600 revolutions per minute, of 250 gallons per minute at 60ft. head. It discharges through a 4in. Venturi meter into the 12in. main, or, when required for testing purposes, direct into the suction tank. This pump was also presented by Mather and Platt, and the motor by Dick, Kerr and Co., Limited. Complete tests, involving the determination of both characteristics and efficiencies, can be made on either of these pumps. The third pump is a two-stage turbine pump, with a capacity of 200 gallons per minute, when running at a speed of 1650 revolutions per minute at 150ft. head. It is used to supply water at 90ft. head to two small Pelton wheels of about ¾ and 2½ horse-power respectively.

There is also a small reaction turbine giving 2 horse-power at 40ft. head. This turbine is run with water drawn from the tank, and brake horse-power and efficiency tests can be carried out.

On the south side of the laboratory—as shown in Fig. V., already referred to—there is a steel tank, 4ft. by 4ft. by 36ft., built up of pressed steel plates, and presented by Braithwaite and Co., Limited. It is divided into three sections, and is arranged so that water can be let into the first section, after passing through a Venturi meter. The water then flows over a V-notch and two weirs, and finally through a water switch into one or other of two calibrated tanks, which hold about 250 and 2000 gallons respectively. By means of the switch, the water can be run into either tank for a definite time, and the rise of level can be measured by means of a hook gauge. In this way accurate measurements of flow can be made, and the formulæ for the flow through a Venturi meter, over a V-notch, and over a rectangular weir can be checked. It is also possible to calibrate the Venturi meters which are used in connection with various experiments in a similar manner.

Pipe friction experiments can be made on three pipes, of ¼in., $^{5}/_{16}$in. and 3in. diameter respectively. In the first two, velocities above and below the critical velocity can be used, and in the last, velocities of from 1ft. per second to 10ft. per second—*i.e.*, from about 10 times to 100 times the critical velocity—are employed. In the 3in. pipe, also, the loss of head due to various bends and elbows and loss caused by enlargement and contraction in diameter can be measured. Various other experiments can be made, including the flow of water through a small orifice and a small Venturi meter, and the calibration of a 3in. Ensign meter, which was presented by Mr. Philip Bright. Practically the whole of the piping used in this department was presented and erected by Stewarts and Lloyds, Limited.

The Metallurgical Laboratory.—The metallurgical laboratory is equipped—as shown in Supplement, Fig. VI.—with apparatus suitable for the study of metallography, and, in addition, there is a small chemical laboratory attached to it. The equipment of the main laboratory comprises two furnace benches, one of which has a range of gas-fired furnaces. Some of these furnaces are capable of being raised to extremely high temperatures. The other bench carries five electric furnaces, each of which can be heated to about 1000 deg. Cent.

The pyrometers, which can be employed with any of the above sources of heat, include some of the latest types, both thermo-couples and resistance instruments being provided, together with a Fèry mirror pyrometer.

The rest of the apparatus comprises a polishing bench and microscopes for both direct reading and photographic work, together with three sets of apparatus, which are used for demonstrating the critical points of iron and steel. In the first of these three equipments, a complete recalescence outfit with recording pyrometer is used. The second equipment is designed to show the sudden loss of permeability on heating, whilst the third employs a dilatometer, which was designed by Mr. J. W. Landon, of the staff of the department, and is arranged to show the expansion and contraction of various steels at the critical temperature.

The chemical laboratory, already referred to, is reserved for the analysis of all ferrous materials, together with analyses of coal and water.

For students who wish to carry out research work in this subject, there is a small research room attached to the metallurgical laboratory, in which various phenomena connected with ferrous metallurgy are at present being investigated.

The Electrical Laboratory.—This laboratory—illustrated by Figs. VII. and VIII. in the Supplement—is exceptionally well provided with examples of various types of electrical machinery. There are five direct-current plants of different sizes, and two-phase and three-phase alternators for 25 and 50 periods. Other apparatus includes several forms of induction motors, a two-phase rotary, a three-phase rotary, a synchronous induction motor, and a mono-phase motor, which can be run in various ways, and a special set of two direct-current machines and two alternators, capable of being coupled in any way and at any fixed phase. There is in addition a number of direct-current machines and motors of various types. The 150-kilowatt submarine coupled set is also available for test in the heat engine laboratory.

The instrument equipment includes a full range of ammeters, voltmeters, wattmeters, reactances and capacities to cover all possible requirements, together with all the usual standard testing instruments, such as potentiometers, unipivot sets, &c. The instruments are arranged upon simple benches made of stone slabs mounted on brick piers.

The apparatus in the separate elementary laboratory for general work and magnetic testing, &c., is exceptionally complete.

A considerable proportion of the equipment in the electrical laboratory has been presented by the leading firms in the industry. Among the firms from whom gifts have been received since the war may be mentioned: British Electric Transformer Company, Limited, British Thomson-Houston Company, Limited, Bruce Peebles and Co., Limited, Callender's Cable and Construction Company, Limited, Crompton and Co., Limited, Electric Construction Company, Limited, Electromotors, Limited, English Electric Company, Limited, General Electric Company, Limited, Hans Renold, Limited, and Western Electric Company, Limited.

Power is supplied at 220 volts from the University station to a sub-station in the laboratory, and there is also an auxiliary source of supply from a motor generator plant, which is coupled direct on the town primary network. The laboratory sub-station includes a balancing booster plant, from which a current of 100 ampères at any voltage from 50 up to about 320 volts can be obtained for special work. A small battery of 220 volts and about 100 ampère-hours capacity is also installed for experiments requiring a steady pressure. Both alternating and direct-current supply are available at some six subsidiary switchboards in different parts of the laboratory.

Reference may also be made to that part of the laboratory which is reserved for wireless telegraphy work. The rooms so set apart are fitted with apparatus for a series of experiments suited to students beginning the subject, and for more advanced work of a research nature for those students who may already possess considerable experience. A steady influx of this class of students is supplied by signal service officers from the Army and Air Force.

The tables in the laboratory are conveniently wired to give the several supplies of alternating current and direct current of various voltages required for experiments with thermionic tubes in their many capacities. Advantage is taken of the 90-cycle town supply for carrying out resonance experiments easily at low frequency as an introduction to similar processes used in wireless technique where measurements are much more difficult. Besides the tapped 220-volt main battery, there is a 40 + 80 volt local Leclanché battery for reception measurements, and a small 500-volt dynamo for triode oscillator tests. A combined capacity and inductance acoustic-frequency bridge is permanently installed, which allows any condenser or coil required in the course of an experiment to be readily measured.

The Department has a large aerial, which is supported on the chimney stack at a height of about 100ft.

Workshops.

The workshops of the Department are still situated on the old site, and until the new lecture-room block, with drawing-offices, on the upperstorey is constructed, they cannot be brought into the space allotted to them in the new buildings, since this space has for the present to be used for drawing-office and lecture-room accommodation.

The workshops are provided with the equipment necessary to give students some training in joinery, patternmaking, smiths' work and machining.

A moderate amount of workshop training and familiarity with workshop methods is required of all students before they take their Tripos examination, but as an alternative to the course of instruction provided in the Department, students are encouraged whenever possible to spend some of their vacations in real engineering workshops. It is held that, if a boy has made good progress in his mathematics and mechanics at school, it is advisable for him before entering the University to serve in an engineering workshop for a period of about six months. This gives him an opportunity of realising what engineering really means, and enables him to get some knowledge of the character of the British workman at an age when he is likely to find the workman sympathetically disposed towards him. If his workshop experience is delayed until his post-graduate days, the kindlier side of the British workman is rather apt to escape his notice.

Appointments Board.

Cambridge graduates generally obtain posts in the first instance through the action of an energetic organisation, known as the Cambridge University Appointments Board. This Board, under the management of its secretary, Mr. H. A. Roberts, has been eminently successful in finding posts for graduates from the Cambridge Engineering School, and even during the past two years of depression in the engineering trade there has been no serious difficulty in finding employment for the large numbers of students who have obtained Honours in the Engineering Tripos. These students obtain their degrees in June, and many employers have learnt by experience that their best plan when seeking recruits is to ear-mark likely youngsters actually before they take their degree. Those who postpone making an application to the Appointments Board until the end of the year find that the demand has by then exceeded the supply. There is an impression prevailing at the public schools that boys should be discouraged from taking up engineering as a profession because it is overcrowded and offers no reasonable chance of employment. The experience of the Cambridge Appointments Board is entirely contrary to that doctrine. There is, it holds, certainly no room in the engineering profession for the boy who is devoid of grit or intelligence, but given these qualifications experience indicates that careers in this direction are as plentiful now as they were in the past, and with renewed activity in the engineering world it is quite possible that in the future there will be an actual shortage of the best type of raw material.

In conclusion, we would express our warm appreciation of the ready facilities which were accorded to us by Professor Inglis and his staff in the preparation and illustration of this article.

Books of Reference.

Kelly's Directory of the Engineers, Iron, Metal and Motor Trades, 1924. London: Kelly's Directories, Limited, 186, Strand, W.C. 2. Price 45*s.* post free.—The sixteenth edition of this valuable Directory is a good deal larger than its predecessors. In it we find a topographical arrangement of names under the cities, towns, and villages of each county, and a classified list of trades with the names of those engaged in them arranged alphabetically. A very useful section of the Directory classifies trade and proprietary names; under this heading no less than 10,000 names are entered. A list is included of iron and steel sections with the makers' names, and also a list of the brands which appear on iron and steel work, with the makers' names and addresses. Trade headings now total about 2000. The book has been thoroughly overhauled and makes a very useful reference book.

Hütte Taschenbuch für Betriebsingenieure. Berlin: Wilhelm Ernst and Sohn. 1924. Price 19.5 gold marks.—This handy book of reference has been specially compiled for the use of the works manager and engineer. Although it was only published early in the present year, the demand for it has, we learn, already proved so large both in Germany and abroad, that a new and revised edition has been found necessary. It is a well arranged book of 1273 pages with twenty-seven chapters and 1431 illustrations in the text. The first part is devoted to materials, testing and measuring, after which there is a short section dealing with standardisation in the German engineering industry. Thereafter follows a series of chapters on factory design and organisation, which includes such subjects as the training of apprentices and improvers, welfare work, and other social and political matters affecting factory life. The various works processes are dealt with in sections, such as foundry work, electric welding and soldering, stamping and pressing, heat treatment, the setting out of machined work and cutting tools. Various machine tools are described and illustrated, and attention is given to recent developments in connection with small tools, which may be operated by compressed air or by electric motors. One of the last chapters deals with woodworking machinery, and the book closes with a short section on vibration and the practice of balancing. This new volume, the contents of which we have briefly outlined, is a worthy addition to the well-known series of Hütte manuals.

The keel of the cruiser to be built by Vickers Limited at Barrow for the British Navy has been laid, and the work of construction will commence immediately. It is estimated that it will take nearly three years to complete the vessel, the building of which will help to relieve unemployment.

Railway Matters.

The fifty locomotives built at Woolwich which have for some time been waiting for a purchaser, have now been reduced to thirty. Twenty of them have been sold to the Southern Railway by the George Cohen and Armstrong Disposal Corporation.

Nearly seven millions more passengers were carried at reduced fares during July last than in the corresponding month of 1923, but one million fewer at full fares. It is gratifying to hear that the increase in the passenger train mileage was only 5.4 per cent.

An additional appointment has been made to the staff of the superintendent of the line, Great Western Railway. This is the office of operating assistant, which is to be filled by Mr. F. R. Potter, who is to be succeeded as London divisional superintendent by Mr. H. R. Campfield from the Plymouth Division.

The position made vacant by the death of Mr. H. R. K. Woodward, the Bristol divisional engineer, Great Western Railway, has been filled by the promotion of his assistant, Mr. E. G. Matheson. Mr. Matheson joined the Great Western in 1905, and, except for the war period, when he was in command of a railway construction company in France, was engaged on new works until two years ago, when he went to Bristol as assistant divisional engineer.

Speaking recently at the annual staff dinner of the London Electric Railways, Mr. H. A. Vernet, a director, who was in the chair, referred to the improvements accomplished by the Underground during the past year. With one exception, the 1922 programme had been completed, at a cost of roughly £6,000,000. The only part uncompleted was the extension of the London Electric Railway at Hammersmith. This extension was in abeyance, but was not abandoned. The 1923 programme, which had only recently been commenced, would cost another £6,000,000. Traffic was not, however, growing at quite the same rate as the facilities. The London Electric Railways now employed 11,000 persons, which was 600 more than a year ago.

A good deal has been said and written of late as to the railwaymen asking for more money. One of the leading men in the engineering world wrote recently that "it was amazing and fatal to all hope of general improvement in industry and trade that the railwaymen, who had already doubled and more than doubled their wages per hour, were asking for a further 10 per cent. advance." In view of these statements, it is perhaps advisable to say that as yet the men have not submitted their demands to the companies, and that if, when submitted, the companies consider them unreasonable they must go before the National Wages Board, on which the public are represented. Whether, as happened with the enginemen nearly a year ago, the men would repudiate the award, remains to be seen.

There is still quite an extensive mileage of railway in this country, to say nothing of the hundreds of miles abroad, on which trains are hauled up and down inclined planes by means of wire ropes. The users of this form of traction will therefore be interested in the report—Cmd. 2246, price one shilling—of Sir Thomas Mottram on the causes and circumstances attending the underground haulage accident at Nunnery Colliery, Sheffield, on December 3rd last. In that case a train of forty-four tubs, carrying 120 workmen, was descending an incline towards the pit shaft when the wire broke, the train got out of control and was derailed. As a consequence seven men were killed. Sir Thomas found no evidence as to the unworthiness of the wire rope, but he criticises the methods of examination and of the way in which the records of the inspections were kept. He recommends that the Coal Mines Act, 1911, be amended so that the prohibition, as to spliced ropes not being used for raising and lowering persons in shafts, shall be extended to their use on inclines where men are hauled. It may be added, in relation to our opening remarks above, that when the Railway Regulation Act, 1871, came into force the Board of Trade required all failures of ropes used in working inclines to be reported. For the subsequent ten year periods the number of failures reported have been twenty, eighteen, six, five, and eight respectively. The biggest records were seven in 1875 and four in 1884. Except three in 1910 there have not been more than two in any year since 1884, and the Ministry of Transport no longer shows them in the accident returns.

The Minister of Railways for the Union of South Africa has appointed a Commission to deal with the question of railway workshops. The following are the full terms of reference of the Commission:—(1) The capability or otherwise of the existing workshops to deal economically and expeditiously with the maintenance of rolling stock at the present time. (2) The necessity or otherwise of enlarging and extending the existing workshops, man power and machinery, with a view to the maintenance and increased quantity of rolling stock. (3) The capability of the existing workshops to manufacture wagons, coaches and locomotives as well as other railway requirements, such as points and crossings, bridge material, spare parts for machinery and plant and the like. (4) The advisability of enlarging and extending the existing workshops and machinery with a view to increasing the work of manufacture of wagons, coaches and locomotives, as well as other railway requirements. (5) The alternative of establishing an entirely independent workshop in which manufacturing work could be standardised, and, if necessary, such maintenance work as other workshops may be unable to undertake, consideration to be given to the question of the site or locality most likely to lead to economic manufacturing costs and expeditious output. (6) The extent to which manufacturing work could be undertaken for other Union Government Departments in any existing workshops enlarged to undertake additional manufacturing work or any proposed new workshop. (7) The question of the increased utilisation of South African products in manufacture and repairs. The Commission consists of Mr. H. C. Hull; Mr. J. G. von der Horst; Mr. Collins, Chief Engineer, South African Railways; Mr. Weakly, a railway engineer; and Mr. Marshall, the financial secretary to Sir William Hoy, General Manager of the South African Railways.

Notes and Memoranda.

In his report on Mines in Scotland for 1923, Mr. J. Masterton, H.M. Inspector of Mines, shows that the use of coal-cutting machines is extending in the mines, the electrically-driven machines of the disc, bar, or chain types being favoured; of the 512 mines at work, 273 made use of coal cutters. The output from the machines was 17,348,494 tons, an increase of 3,039,021 tons over the previous year's output.

The results of tests made on ball bearings of stainless steel were given at a meeting of the American Society for Testing Materials. The bearings were of the self-aligning type and were run at varying loads. The results showed their carrying capacity to be only about 10 per cent. to 20 per cent. of that of ordinary ball bearings. They were only slightly superior to bronze and far inferior to ordinary hardened chromium carbon steel ball bearings.

We learn from the *Electrical Review* that the London County Council has arranged a course of four lectures, for teachers only, on radio telephony and broadcasting, in order that they may be familiarised with certain problems that have to be solved in school broadcasting. Captain P. P. Eckersley, the chief engineer of the British Broadcasting Company, will give the lectures at the Polytechnic, Regent-street, on Friday evenings in the autumn term.

One of the most perfectly lighted stretch of road in the world is situated upon the Lincoln Highway a few miles south of Chicago. Twenty-eight concrete standards, spaced 250ft. apart, each carrying a 250 candle-power electric lamp, equipped with a reflector which throws the light evenly upon the road bed but not beyond it, constitute the lighting equipment. During the course of a year these electric lamps are turned on by a master switch a total of 4000 hours and the yearly cost is less than 25 cents per foot of road illuminated.

Wireless telephony has been seized upon as a valuable aid to the conduct of business by a number of business houses in Greece, where the wireless regulations permit of the private use of this means of communication. Four important firms are already equipping their premises with Marconi wireless telephone sets to link up their head offices in Athens with their branch offices in the Piræus, and further inquiries for similar sets have been received from other commercial firms. This type of wireless telephone set has been designed for use by people possessing no technical knowledge, and is as easy to operate as the ordinary Post Office telephone.

According to the *Iron and Coal Trades Review*, Professor Dr. Formanek, of the Karls University, Prague, has discovered a new motor spirit to which the name "Dynalkol" has been given. It is a mixture of benzol and alcohol to which about 1 per cent. of naphthalene or 1 per cent. of tetralene, or 5 per cent. of ether, has been added. This discovery promises to be important for Czecho-Slovakia, which now imports about 30,000 tons annually of petroleum spirit. It is estimated that under existing conditions the quantity that could be produced from domestic sources would be sufficient to supply about half the requirements of motor spirit of that country.

Marconi apparatus specially designed for the reception of broadcast programmes at sea has now been fitted on a dozen ships, and is giving very satisfactory results. This installation consists of the Marconi Marine V 4, which is similar to the standard V 4 set with the addition of two protective tuning circuits. It is arranged to operate the loud speakers or telephones through transformers, so that any chance of the high-tension supply becoming ineffective through the action of salt water, &c., is obviated. One of these sets was carried by the motor yacht Naz-Perwer on a recent voyage to Norway. At Bergen the Aberdeen station was received clearly during daylight, and at night Aberdeen and Newcastle were heard up to about 100 miles north of Bergen. The Chelmsford station was received during practically the whole of the cruise, including times when the vessel was landlocked in the fjords 200 miles north of Bergen.

In connection with a contract for a large storage battery for the Hull Corporation, the Chloride Electrical Storage Company, Limited, is introducing a new system of supporting the cells which does away with the usual wooden stillage for large batteries. The arrangement consists of a number of tall pedestals made of glazed stoneware surmounted by porcelain insulators; four, six, or more such pedestals carrying each cell. Before erecting the battery it was decided to test the pedestals severely, to ensure that they would carry the weight for which they were designed, and also that they would not chip or splinter at the feet through surface inequalities of the "metalline" brick floor of the accumulator room. The test load of 8000 lb. was supported by four of the insulators, the weight having been obtained by stacking "pigs" of lead on a wooden platform. The insulators under test showed no distress or tendency to crack or splinter.

It is estimated, states the *Ironmonger*, that in the Chinese Province of Chekiang alone more than 100,000 people are engaged in making tinfoil. The chief use of the substance is for sacrificial purposes. Age-old methods of beating are still employed in reducing small cubes of the material to a paper-like thinness. While in Europe lead is now commonly the foundation of "tinfoil," in China it is still made of tin. The tin is purchased in slabs from 50 lb. to 100 lb. each from Shanghai. The slabs are melted in the workshops at Ningpo and poured into moulds containing many holes about an inch square, the tin being thus reduced to ingot form. The ingots are taken out from the moulds when they are cold and beaten into a finished paper of about 2½ft. square. Tremendous pounding is required to transform the square slab, hammer and steel plates being the utensils employed. As soon as the foil has reached the desired thinness, the paper is attached to it by moisture, after which the paper and metal are baked together over a fire. The next process is to trim the edges and to cut the material into four sheets, which are made into books of 1000 sheets each. These are again cut and then marketed. When the foil reaches the retail dealers it is again divided into pieces about the size of a post card, in which size it is sold to the users.

Miscellanea.

The Sunderland District Electric Tramways Company has decided to abandon the entire tramway system and substitute motor omnibuses.

According to a report issued by the Dominion Bureau of Statistics, the production of crude petroleum in Canada in 1923 was 170,169 barrels, valued at 522,018 dollars, as compared with 179,068 barrels, valued at 611,176 dollars, in the previous year, a decline of approximately 9000 barrels.

It is reported from Bilbao that trials have taken place of the first electric locomotive constructed in Spain, which has been built by the Nervion workshops belonging to the Constructora Naval for the Northern of Spain Railway Company. Five other electric locomotives are being constructed in the same works for the Northern Railway Company.

We hear that the city of Paris is organising a competition to determine the best type of shock absorber for motor vehicles, the prizes amounting to 50,000f. Entries will close on March 31st, 1925, and trials will take place in October, 1925. Vehicles which weigh less than 2 tons, loaded, are excluded from the competition. Particulars can be obtained from La Direction des Travaux de Paris (Secrétariat), 98, Quai de la Rapée, Paris.

Excellent progress was reported at the recent annual meeting in Paris of the Société de Halage Electrique, which operates a system of electric haulage on several of the canals in Northern France. The traffic electrically hauled during the past year amounted to 155,578,212 ton-kilometres, as compared with 105,830,287 ton-kilometres in the preceding twelve months. It was stated that on one canal system 90 per cent. of the boats are now electrically hauled, the remaining 10 per cent. being drawn by horses belonging to the boat owners.

An all-electric exhibition is to be held at Cardiff at the end of January, and the Electricity Committee recommends that £1500 be voted for its assistance. The Committee proposes also that £2000 be allocated for the purchase of electric cookers and that premises be obtained for the purpose of a temporary show-room pending a Sub-committee reporting further on the permanent scheme. The scheme recommended by the engineer, allowing 50 per cent. off ordinary rates for shop window lighting and advertising signs, is approved by the Committee.

In an address delivered at the opening of a miners' institute and sports ground at Erdington, near Doncaster, recently, Mr. Charles P. Markham, of the Staveley Coal and Iron Company, said that the railways were to no small extent responsible for the present depression in our export trade. They had doubled their fares for everything they carried, from a baby to a ton of coal. In Germany, on the other hand, railway freights had dropped to pre-war level; and naturally Germany had knocked us out of the markets we had in Norway, Sweden, Denmark and Holland for South Yorkshire coal.

The Canadian smelter output of cobalt, computed as the metal contents of cobalt oxide, nickel oxide, and mixed oxides, produced during the first half of the year, together with the cobalt contents of cobalt ores exported from the mines, and including the cobalt contained in speiss residues exported, amounted in all to 481,411 lb., as compared with 538,018 lb. produced during the first half of 1923. The principal producing company was the Deloro Smelting and Refining Company, at Deloro, Ontario, treating silver-cobalt ores and marketing silver, arsenic, cobalt oxide, metallic cobalt, cobalt salts, nickel oxide, and mixed oxides of nickel and cobalt.

The latest extension of building and plant at the Leek electricity works, which was opened on October 1st, included a duplicate of the 600 brake horse-power National vertical tandem gas engine installed in 1922. During the speeches at the opening ceremony reference was made to the extensive growth of the undertaking during the past few years, and to its profitable nature. It was stated that for the year ended March, 1924, the total electricity output for the station was 1,642,000 units, the average price being 2.8d. per unit; that for the last two or three years there had never been even a temporary or partial failure of supply; and that the station was producing current which was being sold at a cheaper rate than obtained in any town in the country with an undertaking of anything like a similar size.

An uncommon but nevertheless original position has been assigned, we understand, to the Sperry master gyro-compasses which will be installed in the new Canadian Pacific steamers Princess Kathleen and Princess Marguerite. From the outside of one of the public rooms on the boat deck a few straight stairs divide into two curved stairways which terminate on the promenade deck and the space between them will be utilised for the gyro-compass compartment. The open, or forward, side will be closed in by a semi-circular plate glass screen and the master compass will be specially finished to harmonise with the surrounding woodwork. This arrangement will enable the passengers to see the compass in operation and, no doubt, will be a source of considerable interest. The repeater compasses and automatic course recorder will, of course, be on the bridge.

A new Fairey seaplane has been built for service in British Guiana between the plantations of a company and the nearest township, and has been equipped with wireless apparatus by Marconi's Wireless Telegraph Company, Limited. It has been launched for tests at Hamble, near Southampton. This machine has been specially designed to carry white men who fall ill with fever on the plantations to the nearest place where they can obtain treatment. Hitherto the journey, though little more than 200 miles, has taken seventeen days owing to the many rapids on the river necessitating porterage, and many sick men have not survived it. The seaplane will accomplish the distance in little more than two hours—the biggest reduction so far obtained on any route. The Marconi installation will enable telegraphic or telephonic communication to be carried on with both ends of the route. A special wireless ground station has been erected on the estates to work in conjunction with the seaplane.

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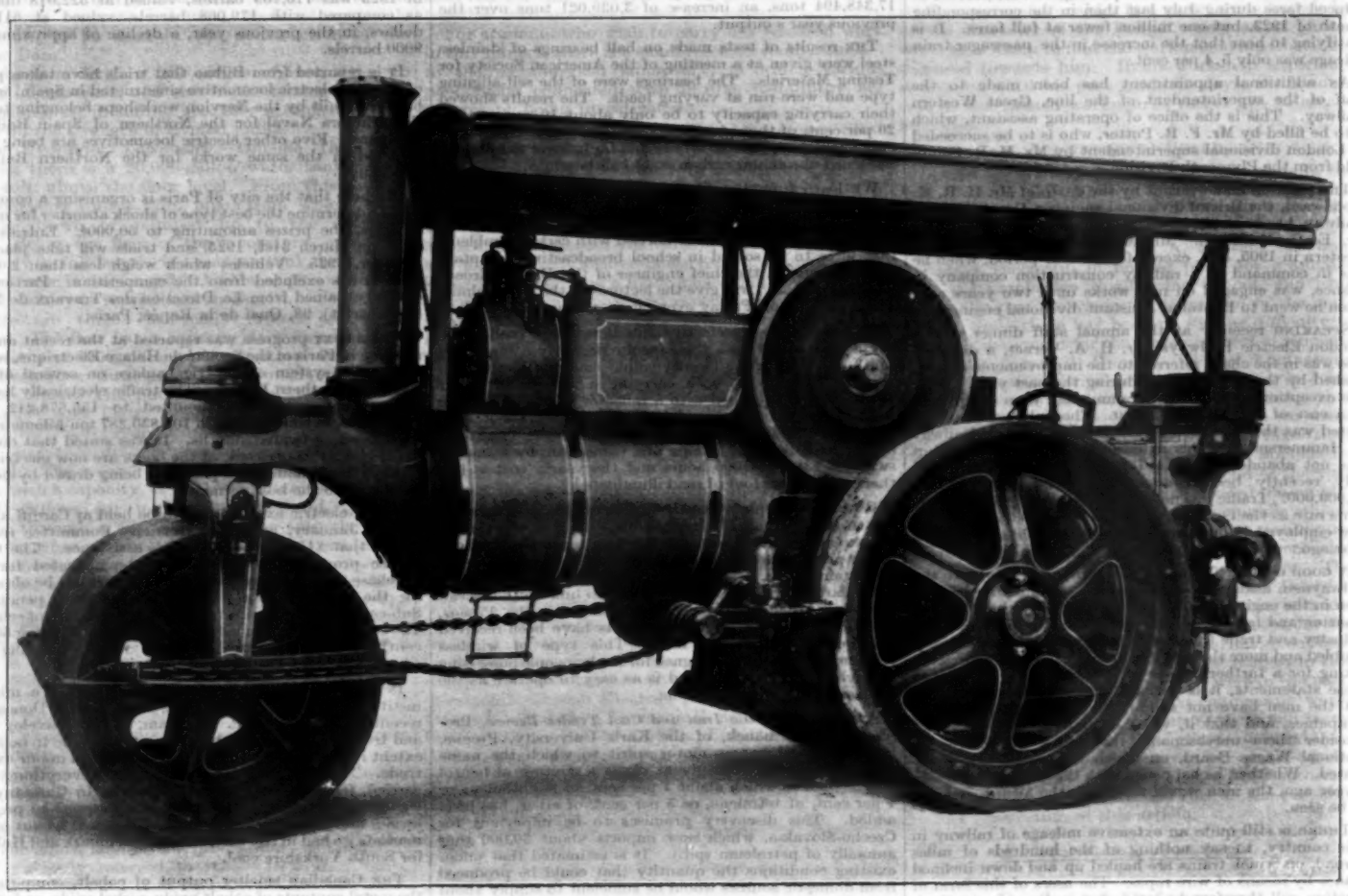
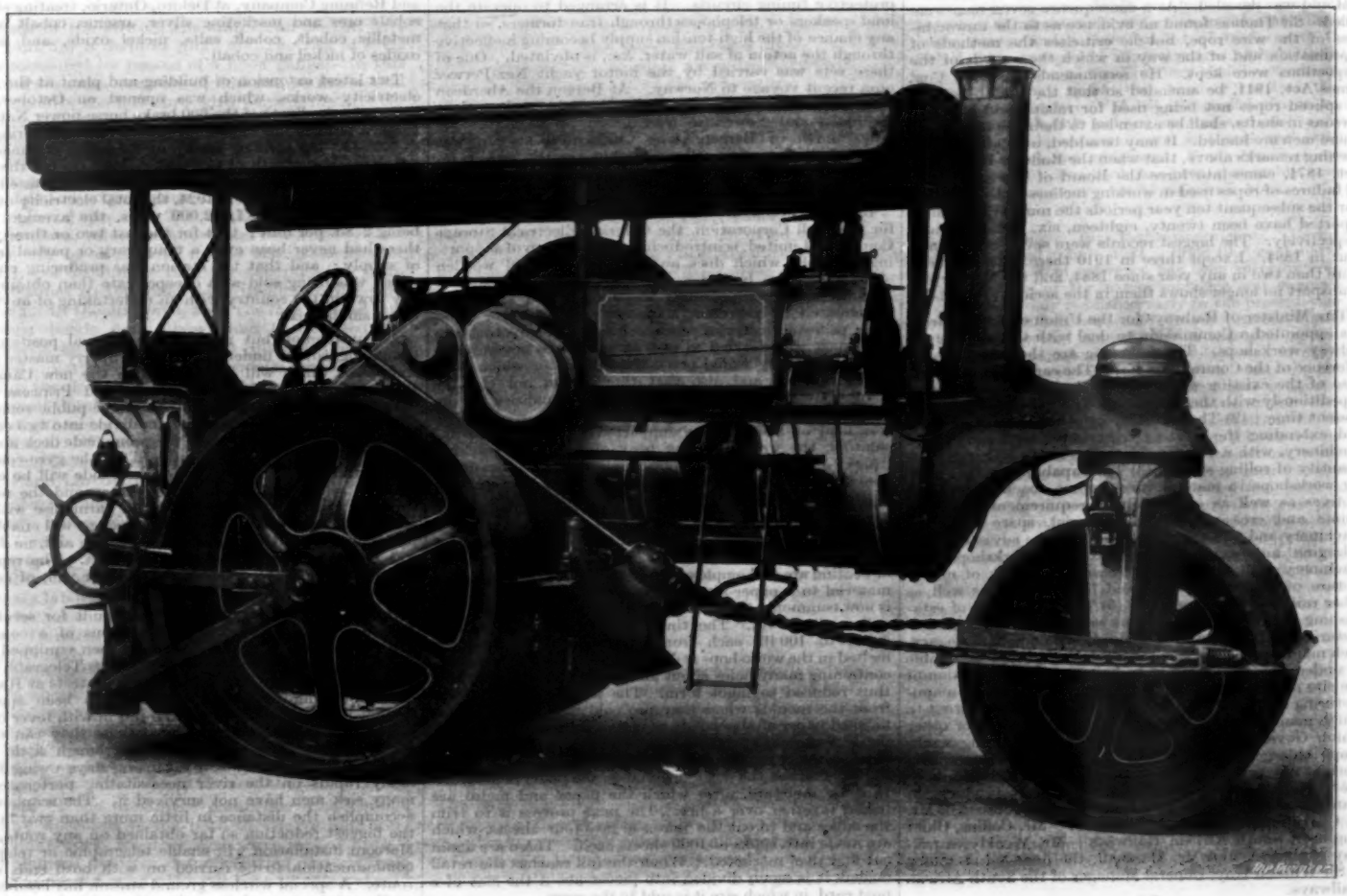
(For description see page 477)





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TWO-PAGE SUPPLEMENT—CAMBRIDGE UNIVERSITY ENGINEERING LABORATORIES.

THE ENGINEER.

OCTOBER 24, 1924.

Admiral Sir Percy Scott and his Work.

IN the closing years of the nineteenth century several events occurred to focus public attention on the subject of naval gunnery. The importance of accurate shooting by ships which had been built for the specific purpose of mounting powerful ordnance was apparent even to the lay mind. Unless a ship of war could use her guns with effect, she was obviously unfitted to take her place in battle. Yet at the period in question this vital branch of training was neglected. Though the gun itself had been enormously improved in power and precision, this improvement was not reflected in the results obtained at target practice. The Fleet's percentage of hits to rounds rarely exceeded thirty, though the conditions under which practice took place were far from onerous. Critics ascribed this poor performance to the conservatism of the older officers, many of whom preferred a smart appearance of ship and crew to prowess in the working of the armament. The destruction of Cervera's well-armed but poorly trained squadron in the Spanish-American War of 1898 showed the terrible penalty of neglecting gunnery. No one knew how the shooting of the British Fleet compared with that of other navies, but it was evident that entirely new methods of training the man behind the gun would have to be adopted if better results were to be obtained.

Already in the early 'nineties Commander Percy Scott, of the Excellent gunnery school, was trying to introduce changes, both in routine and in the mechanical aids to marksmanship, which he held to be essential to greater efficiency; but it was not until he became Captain of the Scylla, in May, 1896, that he was free to give his ideas full play. In his own words, "gunnery was a difficult problem to attack. There were no efficient targets, the gun sights were bad, and the expenditure of ammunition had to be carried out at stated times and under conditions that afforded little scope for instruction." How he tackled the problem, and with what measure of success, is now common knowledge. Briefly, he began by fitting telescope sights, and substituting a service rifle for the one-inch tube which had hitherto done duty for sub-calibre firing. Thanks to these devices, the Scylla's practice became much more accurate, but the difficulty of training men to keep their sights on the target when the ship was rolling still remained. It was overcome by Scott's invention of the "dotter," an instrument that reproduced the movements of the target in a seaway. After a short course of instruction with the "dotter," the gunners of the Scylla went out for their next firing test, and amazed all beholders by the certainty with which they hit the target in spite of the rolling of the ship. At the prize firing in May, 1899, the Scylla's six 4.7in. guns fired seventy rounds and made fifty-six hits, a score of eighty per cent. This performance had never been approached before. Captain Scott's next ship was the Terrible, and it was in that vessel that he introduced the "deflection teacher," a contrivance that taught the gun-layer to readjust his sights in accordance with the last shot. Another invention of his was a machine for practising rapidity of loading. While in command of the cruiser Terrible, during the South African War, he designed the mountings which enabled heavy naval guns to be used in the field, and incidentally saved Ladysmith. As the Terrible, like the Scylla, made eighty per cent. of hits at prize firing, the extraordinary value of Scott's system of training was no longer in doubt. In April, 1903, he was appointed Captain of H.M.S. Excellent, the Gunnery School, and remained there two years, during which he incurred disfavour at the Admiralty by his frank criticism of the gun sights then in use. His next appointment was Inspector of Target Practice, and in succeeding years the gunnery of the Navy advanced by leaps and bounds. In 1907 the average of the whole Fleet was 79.1 of hits out of every 100 rounds fired—practically double the average of 1904. The perfection of the Scott director dates from this period, though it was not officially taken up until 1910, when an experimental installation was fitted in the battleship Neptune. In a competitive firing trial between the Thunderer and the Orion in 1912, the former having the director system and the latter being without it, the Thunderer made six times as many hits as the Orion at a range of 9000 yards. Having regard to this striking result, it was unfortunate that so much time should have been lost in equipping the Fleet with directors. On the outbreak of war only a few ships had been so fitted, but then the work was pushed on so rapidly that Jutland found nearly all the Grand Fleet capital ships with director control for their main armament. Admiral Scott had retired in 1913, and one of his first acts on regaining freedom of the pen was to write a letter to *The Times* which, in effect, condemned the battleship as an anachronism. This letter, which appeared exactly two months before the outbreak of war, naturally provoked a heated controversy. Naval opinion as a whole expressed emphatic dissent from his views, nor were they borne out by actual experience in the conflict that followed. That the battleship held its own against the underwater menace, and performed its traditional functions without serious interference from enemy submarines, is admitted by most unbiassed judges. But Sir Percy Scott's faith in the submarine remained unshaken. Almost to the day of his death he was writing vigorous denunciations of the great ship and the folly of the Admiralty in building new Dreadnoughts, instead of converting the Navy into a composite force of fast cruisers, submarines and aircraft.

His death has deprived the country of a loyal and singularly able servant, who did as much as any man to prepare the British Navy for its supreme ordeal. That his controversial methods were not always above criticism we should be the last to deny. Believing fervently in every cause he espoused, he was apt to be intolerant of opposition; nor would he condescend, as a rule, to argue a case on its merits. In his war against the battleship he weakened his cause by ignoring technical points which had a vital bearing on the issue. For example, he never admitted that the battleship of to-day is less vulnerable to underwater attack than her predecessor of ten years ago. Nor shall we be doing him an injustice if we suggest that the exercise of a little more tact and patience on his part might have smoothed his relations with authority and thus expedited many of the reforms which, he always contended, were held up by departmental obstinacy. It is, however, not as a disputant, but as a pioneer of scientific gunnery, a zealous sea officer, and an ardent patriot that Sir Percy Scott will be held in grateful remembrance by his country. Of him it can be said with perfect truth: "He taught the Navy to shoot straight." And we are very sure that he would have asked no better epitaph.

Waste.

WE reprint on another page the major portion of the presidential address which Mr. Tom Westgarth read to the North-East Coast Institution on Friday last. We need not commend it to the attention of our readers; it is sufficient to say that it is just what we should have expected from its author—keen where the technical aspect of waste

is concerned, and kind where the human aspect appears. It is the common practice of us all to give more attention to our merits than to our defects. We note improvements with pride, but we neglect to observe what a large margin of untouched territory still remains on the wrong side of the account. It is frequently claimed for engines and mechanisms that they are five or ten per cent. better than their predecessors, but it is sometimes forgotten that such economies indicate very small actual improvement. If an engine has a thermal efficiency of ten per cent., and we increase its efficiency by one-tenth, all we have done is to make its thermal efficiency one per cent. better than it was before. Mr. Westgarth obliges us to turn our attention from what we have done to what we have left undone; he makes us look from the pleasant side of the balance to the unpleasant side, and to consider the vast waste that still continues despite our advances. It might be a salutary thing if we got ourselves into the habit of quoting efficiencies from the opposite end of the scale. Thus, instead of saying that an oil engine had an efficiency of thirty per cent., we should say it had a deficiency of seventy per cent. By so doing, the waste that exists would be kept continually before our eyes.

Mr. Westgarth devoted part of his address to technical waste, the waste of natural energy, and part of it, the larger part, to the waste of human energy through industrial friction. In this latter connection he quoted, as so many people do, from the Board of Trade returns of the total number of days lost owing to disputes. We have pointed out before, but it may be worth while doing so again, that those figures are rather deceptive. For example, in 1923 nearly eleven million working days were lost, but since there were well over eleven million people engaged in industries, the actual loss *per person* was less than one day—no more, let us say, than six hours per year for each artisan in the kingdom. Now the reduction from fifty-four hours per week to forty-eight also meant the loss of six hours per person, but per week instead of per year, so that, in fact, as much time is lost in one forty-eight hour *week* as in a whole *year* from strikes! Measured on this kind of scale, the short week is fifty times as bad as all the strikes of a year. As a matter of fact, it appears that the introduction of the eight hours' day in the engineering and kindred industries has reduced output by something in the neighbourhood of ten per cent. It is probable—the great labour disputes excepted—that the total loss caused by strikes and lock-outs in any one industry is rarely so great as that. Measured by lost time only, a strike or lock-out must last five weeks before ten per cent. of the possible working days per year are lost. We point to these figures not to palliate industrial disputes, but in the first place to show that figures quoted in the mass and without qualification, as these are, give wrong impressions, and, in the second, to show how much we have sacrificed by the adoption of the short week. If we add to these lost hours the time wasted in factories by slackness, it will, we think, be appreciated that whilst labour disputes rob us of a large amount of valuable time, far more is lost by short hours and indifference throughout the whole year. We may compare the conditions to those of a man who is rendered chronically inefficient by ill-health and one who loses a week or two now and then through illness. There can be no doubt which of the two is the better man. And so it is with industry. Bad as labour disputes are, they are not doing us so much injury economically as the shortening of the hours of work and the general slackness that prevails. Mr. Westgarth rightly speaks of "the dreadful waste caused by people not doing a fair day's work for a fair day's pay," and adds that, in conjunction with the short hours we work, it is, in his opinion, "the greatest cause of the unduly large cost of our productions and the main cause of so much work going abroad." He does not, as will be seen by those who read his address, hold the men alone to blame. "I fear," he says, "all classes of the community—masters and workmen alike—have yet to complete their recovery from the demoralisation of the war-time, and are still wasting much of their energies, and it is a very serious question how to stop all this waste going on throughout industries." We agree with him very heartily. The desire for "a good time" which, strange as it may seem, sprung up during the war when every second person was having the worst possible time, has remained with us. There can be no manner of doubt that as a nation we do not work as hard as we did, we do not work as hard as our competitors. In that fact we may find a far more fruitful cause of wasted time than in labour disputes. An engineer who has lately returned from Germany told us that in the locomotive trade of that country the hours of work were fifty-four per week, and the men and masters were going at it with a will. "How," he asked, "can we hope to compete when we work only forty-eight hours, and that without keenness?" On this subject we would invite our readers to turn to a short article in to-day's issue, in which Mr. E. T. Good has collected from trustworthy sources particulars as to the rate of wages and the rate of output in several countries. Observe, for example, that the output per man in British collieries is now twenty per cent. less than it was in 1913, and that in the textile trades, where we have reduced the number of hours from fifty-five and a-half to forty-eight, Germany is working at the pre-war hours for wages for skilled labour nearly twenty-five per cent. less than before.

There is much more in Mr. Westgarth's address that merits attention, and we trust it will be read and digested, not only by workmen, but by employers as well. He speaks from a ripe experience and with such a kindly toleration and impartiality that his views must be listened to with equal pleasure by Capital and Labour. The moral, if we may so call it, of his discourse is that employers must not be contented as long as the inefficiency of machines is so high and as long as valuable products are allowed to go to waste, and that the employed must not think that they can work short hours, give an unfair day's work for a fair day's pay, and yet do no injury to the trade of their country, and, in the long run, to themselves. He urges on both the necessity of settling their quarrels by amiable debate, instead of by industrial war, and invites them to consider again the advantages of payment by results and the merits of profit-sharing. We are indebted to him for an essay which puts so clearly before us the sources of technical and industrial waste that we cannot close our eyes to them. If, as we have said above, we can concentrate our attention upon deficiencies—without despondency or rancour—instead of upon small efficiencies, we shall see more clearly the fields for revived endeavour that lie before us.

One Hundred Years of British Railways.

No. XVII.*

PART II.—THE FIRST HALF CENTURY.

THE MIDLAND RAILWAY.

The first unit in the Midland system was the Leicester and Swannington, a railway built to convey coal from Swannington and Coalville to Leicester, where a station was built near the river Soar at West Bridge. This line put the Leicestershire coalfields in as good a position as those of Derbyshire and Nottinghamshire, which, because of their water communication, had been giving better facilities, even though the distance was greater. It was sanctioned by I. Will. IV., c. 58, 1830, and was opened on July 17th, 1832. The engineer was Robert Stephenson. The line had, at first, two inclined planes. One, at Bagworth, was 43 chains in length, on a gradient of 1 in 29, and was self-acting. When, in 1849, a line from the Midland main line at Leicester was built to join the West Bridge Railway at Desford, the gradient of the latter was improved, and the Bagworth incline dispensed with. The other was the Swannington incline, which is still in use and is on a gradient of 1 in 17, falling from the Leicester direction. It is worked by the same stationary engine that Stephenson fixed in 1833. Another curiosity, still to be found on this line, is the Glenfield Tunnel, 1 mile 36 yards in length, between West Bridge and Glenfield. Its dimensions are such that loads over the West Bridge branch are limited to 7ft. 7in. in width and 12ft. 10in. in height, as against the standard 9ft. wide and 13ft. 6in. high.

But whilst the beginning of the Midland is found in the Leicester and Swannington Railway, the three main members of the system were—(1) the Birmingham and Derby, (2) Midland Counties, and (3) North Midland. Not one of these lines was sanctioned until 1836—four years after the Leicester and Swannington was opened. They are named here in the order in which they were sanctioned. Actually, the Birmingham and Derby scheme originated later than the other two.

The Midland Counties may be regarded as the direct result of the Leicester and Swannington. The construction of the latter, as said above, placed the Leicestershire coalfields in as good a position as those of Derbyshire and Nottinghamshire. The colliery proprietors in the latter district were alarmed, and, having seen in their own local railway, the Mansfield and Pinxton—Article No. V.—the benefits of railway communication, they determined to have a railway from Pinxton to Leicester. The aid of the promoters of the Liverpool and Manchester Railway was sought, and was secured on condition that the line was continued southwards from Leicester to Rugby—there to join the London and Birmingham—and northwards from a point near where the railway crossed the river Trent, to Derby, and that a branch from the same point to Nottingham was constructed.

It will be seen that the construction of the railway would provide through railway communication between London and Derby. This prospect prompted the idea of a line from Derby to Leeds, of which George Stephenson was the engineer. Its promoters were not friendly to the Midland Counties, and did not relish the idea of handing over any traffic for London to that company. One reason for this ill-feeling was that the Midland Counties people talked of extending their line northwards from Pinxton to join the North Midland, near Chesterfield, thus robbing the North Midland of the mileage between Derby and the junction near Chesterfield. As a consequence of this want of harmony, the Birmingham and Derby line was proposed. It was to form a connection between the North Midland and the London and Birmingham at Stechford, and to have a branch from Whitacre to Stonebridge—now known as Hampton-in-Arden—where another junction was to be made with the London and Birmingham. The line was opened between Derby and Hampton on August 12th, 1839, and from Whitacre to Lawley-street, Birmingham, on February 10th, 1842. George Stephenson was the engineer. The most important work on the line is the Anker Viaduct at Tamworth, which has one arch of 60ft. span and eighteen arches of 30ft. span. Birmingham later became the junction point, and Hampton fell to a very secondary place. So much so that eventually there was only one train a day in each direction between it and Whitacre. Even that service was withdrawn during the war, and has not been restored.

Three important works on the Midland Counties Railway are the viaduct over the river Avon just outside Rugby, which has eleven brick arches, each of 50ft. span; the viaduct over the river Trent near the junction; and Redhill Tunnel, just to the south of the Trent. A very ticklish piece of work between Derby and Trent was a diversion of the Derby Canal and the provision of a new lock, which had to be constructed without interfering with the traffic on the canal. The engineer was Charles Vignoles. The Midland Counties was one of the few lines built at that time without the aid of either of the Stephensons. The standing that Vignoles then held—he made the survey of the Liverpool and Manchester as constructed—and that to which he attained are sufficient proof that the Midland Counties did not suffer from not having Stephenson as its engineer. The maximum gradient was 1 in about 340, of which there were 5 miles 10 chains in all, and the next steepest 1 in 400, with 11 miles 60 chains. The railway was opened from Derby to Nottingham on May 30th, 1839; from Trent to Leicester on May 5th, 1840; and from Leicester to Rugby on July 1st, 1840.

The North Midland was opened from Derby to Rotherham—to be called later Masborough—on May 11th, 1840, and from Rotherham to Leeds on June 30th, 1840. From an engineering point of view, the North Midland was the most interesting of the three. George Stephenson, as has already been remarked, was the engineer. The line was 73 miles in length, and among the important works may be mentioned the Milford Tunnel, 836 yards; Clay Cross Tunnel, 1760 yards; Chevet Tunnel, 600 yards; the Oakenshaw Viaduct, of five arches, each of 60ft. span; the Calder Viaduct, of one arch, of 90ft. and five arches of 60ft. span; Chevet Viaduct, of thirteen arches, each of 20ft. 6in. span; Barnsley Viaduct, 1000ft. in length, in four spans, with stone piers and girder superstructure; and a viaduct of thirty arches, of 25ft. to 30ft. span, over the river Dun. A very interesting piece of work was undertaken at Bull Bridge, just north of Ambergate, where the railway crossed the river and passed under the Cromford Canal. An iron caisson, 150ft. long by 9ft. wide and 6ft. deep, was made, and was sunk in the canal and there embedded. The work was done within twenty-four hours, and without any delay to traffic on the canal.

The big station at Derby was provided by the North Midland. Its importance in those days may perhaps be judged from the fact that when the Victoria Station, Manchester, was opened in 1844, it was said of the latter that for "extent and accommodation it eclipsed the celebrated station at Derby."

The North Midland terminus for Leeds was in Hunslet—now the goods yard—and it was not until July 1st, 1846, that the railway entered the Wellington Station, Leeds. On that date the Leeds and Bradford Railway was opened, and a connection therewith was made from Hunslet Goods Junction to just outside the Wellington Station.

In 1844, when George Hudson was chairman of the North Midland, the three companies were amalgamated as the Midland. This step was followed by the opening, on August 5th, 1846, of the line from Nottingham to Lincoln, on September 6th, 1847, of that from Trent to Codnor Park, and two years later the extension of the latter to Pinxton.

* No. XVI. appeared October 17th.

The North Midland did not pass through Sheffield because to do so would have necessitated the climbing of steep gradients through Dronfield. Sheffield was therefore served by an independent railway company, the Sheffield and Rotherham—6 & 7 Will. IV., c. 104, 1836—which ran from what is now the Midland Company's goods station in the Wicker, Sheffield, to Rotherham, and was opened on November 1st, 1838, or eighteen months before any portion of the North Midland was brought into use. It was amalgamated with the Midland in 1845.

By 6 Will. IV., c. 14, 1836, the Gloucester and Birmingham Railway Company was formed. It was to purchase, jointly with the Cheltenham and Great Western Union, the Gloucester and Cheltenham Railway, sanctioned in 1809—see Article No. V. It started at Cheltenham and terminated in a junction with the London and Birmingham Railway at what was Gloucester Junction, Birmingham, and used that company's station at Curzon-street. The outstanding feature on this railway was the Lickey incline between Bromsgrove and Blackwell, a distance of 2 miles 5 chains, on a gradient of 1 in 37.7. Both Stephenson and Brunel favoured this section being worked by an inclined plane, but Edward Bury said it could be worked by locomotives—and so it was. The locomotives were of American design, and were built by Norris, of Philadelphia. The reproach that engines had to be obtained from America to work the Lickey incline was removed by J. E. McConnell, the locomotive superintendent, who built a tank engine for the work. Major-General Pasley, when reporting to the Board of Trade on August 19th, 1842, said that greater power for adhesion had been obtained by doing away with the tenders and fitting the engines in such a manner that all the coke and water necessary were carried on them. The engines had cylinders 12½in. by 20in., and weighed 14 tons. General Pasley added: "I believe that this advantageous arrangement is a novelty first introduced on this railway, and also that there is no instance of goods or passenger trains being drawn up so steep an inclined plane as this by locomotive power, on any other railway. The whole of the work on it is done by these bank engines, as the others never ascend or descend the Lickey incline. On timing one of these bank engines, to which eight carriages, supposed to weigh 40 tons in all, were attached, I found it was drawing them up at the rate of 12 miles an hour." The line was opened thus:—Cheltenham–Bromsgrove and the Tewkesbury branch on June 24th, 1840; Bromsgrove–Cofton, September 17th, 1840; Cofton–Camp Hill, December 17th, 1840; Camp Hill to the London and Birmingham, August 17th, 1841.

South of the Gloucester and Cheltenham came the Bristol and Gloucestershire Railway, which was actually the earliest section of the Midland Railway, having been sanctioned in 1828, two years before the Leicester and Swannington. The Act—9 Geo. IV., c. 93—authorised a line to be built from the harbour on the east side of the city of Bristol, by Mangotsfield, to Coalpit Heath. On the same day there was authorised, by c. 94, the Gloucester and Avon Railway, which was to run from the Kennet and Avon Canal at Keynsham to Rodway Hill, Mangotsfield, where it was to join the Bristol and Gloucestershire. Both were railways of 5ft. gauge. Its extension to Bristol, Temple Mead, the terminus of the Great Western and the Bristol and Exeter, and from Westerleigh near Coalpit Heath to Standish Junction, Stonehouse, where it was to join the Cheltenham and Great Western Union, and the enlargement of the gauge to 7ft. were subsequently sanctioned. The remodelled and lengthened line was opened on July 8th, 1844.

Under the Act just named, the Bristol and Gloucester had to continue to accommodate the Gloucester and Avon for a distance of about 2 miles 50 chains. Instead of having a third rail for the broad gauge, as required by the Act, Brunel, with his usual high-handed manner, laid the two rails for the 5ft. gauge within the two for the 7ft. The existing track of the former was left in, and consequently the rails were of unequal height, the siding connections were of what the Board of Trade inspector called a very objectionable character, and the whole was "highly dangerous to the safety of the public travelling on the Bristol and Gloucester line."

In 1845, the Birmingham and Gloucester and the Bristol and Gloucester combined their interests and became the Bristol and Birmingham, and in 1846 the Midland absorbed both companies. In 1848 powers were given to the Midland to build its own line between Gloucester and Standish Junction, and to convert the line thence to Bristol to mixed gauge. The conversion was completed on May 29th, 1854, when for the first time standard gauge trains entered Bristol. It may here be remarked that as a mark of appreciation of its action in obtaining possession of these lines and so keeping the broad gauge from getting control the London and North-Western gave the Midland Company access to its station in Birmingham on payment of a nominal rental of £100. The terminus at that time was Curzon-street, but when New-street was fully opened in 1854 the conditions were made to apply to that station, and remain so to this day.

The Leeds and Bradford was opened on July 1st, 1846, and by September 7th, 1847, railway communication reached Skipton, whence the branch to Colne to join the East Lancashire was opened on October 2nd, 1848. Hudson's fears of the London and York led to the building of a line from Syston on the Midland Counties to join the Eastern Counties at Peterborough, which company arrived at that place on January 1st, 1847. It was completed on March 20th, 1848. At Skipton the North-Western Railway—generally called the Little North-Western to distinguish it from the London and North-Western—began and ran to Morecambe, with a branch from Clapham to Ingleton and from its station—Green Ayre—in Lancaster to the Lancaster and Carlisle's Castle Station. These further extensions were completed by June 1st, 1850.

In order that the purchase of the Leicester and Swannington by the Midland could be justified, it was necessary that that line should be connected with the Midland main line at Leicester. An extension in the opposite direction, so as to join the line to the West at Burton-on-Trent, was also desirable. The route of the original line was altered and a double line provided. The line from Burton to Swannington was opened on October 2nd, 1848, and from Desford Junction to Knighton on August 1st, 1849. The opening of the latter portion was postponed because of an objection of the Board of Trade inspector to inefficient coal wagons being attached to trains carrying passengers.

The beginning of the Midland's connections with Manchester was the construction of a line from Ambergate to Rowsley—opened on June 4th, 1849. This line was gradually extended so that Buxton was reached on June 1st, 1863, and New Mills on January 24th, 1867. From the latter place running powers over the Manchester, Sheffield and Lincolnshire took the Midland into Manchester, London-road. The celebrated High Peak Railway joins the Midland 4½ miles north of Ambergate. Close to that junction is Lea Wood Tunnel, at both ends of which the railway crosses the river Derwent and passes under a canal. The canal at the south end is the Cromford Canal, and that at the north end is its Lea branch. The summit of the line is at Peak Forest, which is 982ft. above Ordnance Datum, as compared with 156ft. at Derby, 36 miles to the south. There are numerous tunnels, of which the most important is Dove Holes, 2984 yards long, immediately south of the summit and at the beginning of 9 miles of 1 in 90. The first serious accident on the Midland occurred here on September 9th, 1867, when as a result of a collision in the tunnel a coupling broke and a cattle train ran back. In a collision which resulted, four drovers and a little girl were killed.

The opening of the Ripley branch on September 1st, 1856, and the Dursley branch on the 22nd of the same month, was followed by the very important Leicester and Hitchin Extension on May 8th, 1857. The last-named joined the Great Northern at Hitchin, and over it a through service of trains to and from King's Cross began on February 1st, 1858.

A line from Barnt Green, through Redditch and Evesham, to Ashchurch was brought into use in various stages between September 19th, 1859, and May 4th, 1868. Tewkesbury was joined to the Birmingham and Gloucester when that line was opened, and this branch was continued to Malvern on the Worcester and Hereford by two stages, the last of which was completed on May 1st, 1864. On June 29th, 1863, the Hereford, Hay and Brecon joined Hereford to the Hay Railway—see Article No. V.—at Eardisley. A branch from Burton to Swadlincote was opened on June 1st, 1864, and on November 1st of the same year the South Leicestershire of the London and North-Western at Nuneaton, over which the Midland ran to and from Leicester, was joined to the Birmingham and Derby at Whitacre. Other lines constructed about that time were:—Otley and Ilkley (joint with the North-Eastern) with the Midland connecting line from Apperley, on August 1st, 1865; Kettering and Huntingdon, March 1st, 1866; Nailsworth branch, February 4th, 1867; Worth Valley branch, April 15th, 1867; Wirksworth branch, October 1st, 1867; Furness and Midland jointly owned Wennington–Carnforth, June 6th, 1867.

The Spalding and Holbeach, opened on November 15th, 1858, was extended to Sutton Bridge on July 1st, 1862, and on August 1st, 1866, Sutton Bridge was connected with Peterborough and with King's Lynn. These lines subsequently became part of the present Midland and Great Northern Joint Railway.

On September 7th, 1867, the Midland arrived in London—at first with goods traffic—on its own metals. As St. Pancras Station was not ready for traffic, the passenger trains, when the service began on July 13th, 1868, ran to the Metropolitan station at King's Cross, and over the Widened Lines to Moorgate-street. The outstanding feature of the St. Pancras terminus is the roof, in one span of 240ft. by 690ft. in length, and at the highest point 100ft. above rail level. It was built by the Butterley Iron Company to the designs of Mr. W. H. Barlow—at that time the consulting engineer to the Midland and its chief engineer from 1844, on the formation of the company, to 1857. A line from Brent Sidings to the North and South-Western Junction Railway at Acton Wells was opened on October 1st, 1868, and a curve from Childs Hill, to join it, on August 3rd, 1875.

The Midland had hitherto enjoyed a gratifying immunity from serious accident, owing, no doubt, to the splendid discipline of the staff, especially in the traffic department. On October 9th, 1869, there was, however, a collision between the Lincoln–Tamworth mail and an excursion train in a dense fog outside Trent Station, in which seven passengers were killed.

Not until August 2nd, 1875, was any other large work opened. Subsequent to the London Extension came:—Sandal and Walton–Wakefield, August 1st, 1868; Mangotsfield–Bath, August 4th, 1869; Derby–Melbourne–Ashby, opened to Melbourne on September 1st, 1868, to Worthington on October 1st, 1869, and over the re-constructed Ashby Canal lines—see Article No. II.—to Ashby on January 1st, 1874; Chellaston–Castle Donnington–Trent, December 6th, 1869; Chesterfield–Sheffield, including the Bradway Tunnel, 2027 yards, February 1st, 1870; Cudworth–Barnsley, May 2nd, 1870; Earby–Barnoldswick, February 8th, 1871; the Rolleston–Southwell branch off the Nottingham and Lincoln, opened on July 1st, 1847, was extended to Mansfield on April 3rd, 1871; Bedford–Northampton, June 10th, 1872; Yate–Thornbury, September 2nd, 1872; the Ashby and Nuneaton, from Moira East Junction to Nuneaton, jointly owned with the London and North-Western, on September 1st, 1873; Radford–Trowell Junction and Pye Bridge–Ambergate on May 1st, 1875; and Mansfield–Shireoaks on June 1st of that year.

Three important works were opened on August 2nd, 1875. By a short connection, jointly owned with the Manchester, Sheffield and Lincolnshire, from Romiley to the Cheshire Lines at Bredbury Junction, the Midland got access to Liverpool, and by a similarly owned line from Bredbury to Ashburys secured a quicker route to Manchester. But the most important of all was the Settle and Carlisle, which gave the Midland its own line to the Scottish border.

On August 28th there was a collision at Kildwick, when seven passengers were killed. The block system was not in operation, but was gradually approaching Kildwick, and a failure by a signalman to observe the time interval rule and of a driver to respect a distant signal, allowed an express to run into an excursion train.

BOOKS RECEIVED.

Annales des Ponts et Chaussées: Fax. 4, *Tome* 1 *et* 2. Juillet-Août. Paris: 28, Rue des Saints-Pères.

Annales des Ponts et Chaussées Mai-Juin. Paris: Commission des Annales, 28, Rue des Saints-Pères.

Small Electric Generating Sets. By W. Wilson. London: Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 18s. net.

Optical Measuring Instruments. By L. C. Martin. London: Blackie and Son, Limited, 50, Old Bailey, E.C. Price 17s. 6d. net.

Applied Elasticity. By John Prescott. London: Longmans, Green and Co., Limited, 39, Paternoster-row, E.C. 4. Price 25s. net.

The Corrosion of Metals. By Ulick R. Evans. London: Edward Arnold and Co., Limited, 41–43, Maddox-street, W. 1. Price 14s. net.

Platelayers' Guide. Compiled and published by Thomas Summerson and Sons, Limited, Darlington. Sixth edition. 1924. Price 7s. 6d. net.

University College: Calendar of Session MCMXXIV.–MCMXXV. London: Taylor and Francis, Red Lion court, Fleet-street, W.C. 2.

Thermodynamique à l'Usage des Ingénieurs. By Aimé Witz. Paris: Gauthier Villars et Cie., 55, Quai des Grands-Augustins. Price 20f.

Annales des Travaux Publics de Belgique, Deuxième Série, Tome XXV. Publisher: Goemaere, Imprimeur du Roi, Bruxelles, rue de la Limite, 21.

La Soudre Electrique à L'arc Métallique. By S. Frimaudeau. Paris: Gauthier Villars et Cie., Quai des Grands-Augustins, 55, Paris. Price 2 fr. 50.

The Life of Lord Rayleigh. By his Son, Fourth Baron Rayleigh. London: Edward Arnold and Co., Limited, 41–43, Maddox-street, W. 1. Price 25s. net.

Transactions of the Institute of Engineers and Shipbuilders in Scotland. Vol. LXVII. Part VII. Published by the Institution, Elmbank-crescent, Glasgow.

Civil Engineers' Cost Book. Fourth edition. By Colonel T. E. Coleman. London: E. and F. N. Spon, Limited, 57, Haymarket, S.W. 1. Price 10s. 6d. net.

Report of the Empire Motor Fuels Committee: Embodying other Allied Researches. Vol. XVIII. Part I. The Institution of Automobile Engineers, York-buildings, Adelphi, W.C. 2.

The Measurement of Fluid Velocity and Pressure. By J. R. Pannell. Edited by R. A. Frazer. London: Edward Arnold and Co., Limited, 41–43, Maddox-street, W. 1. Price 10s. 6d. net.

Wireless Valve Transmitters: The Design and Operation of Small Power Apparatus. By W. James. London: The *Wireless Press*, Limited, 12 and 13, Henrietta-street, W.C. 2. Price 9s.

The Enlarged Callendar Steam Tables (Fahrenheit Units). By H. L. Callendar. London: Edward Arnold and Co., Limited, 41–43, Maddox-street, W. 1. Price 7s. 6d. Mollier Diagram published separately. Price 1s.

THE first "Bradshaw" was dated October 19th, 1839, and therefore last Sunday was the eighty-fifth anniversary of its publication. Bradshaw was a map engraver in Manchester.

Motor Car Show at Olympia.

No. II.*

In our introductory remarks regarding the Motor Car Show at Olympia, which opened on Friday last, we omitted to mention amongst the notable exhibits of the Show the reappearance of the steam car after several years absence. Our readers who have followed the evolution and development of the self-propelled passenger car will recall that in the early days steam vehicles formed quite a prominent feature of the Show, but after putting up a strenuous struggle the various makers had to admit defeat by the petrol-engined cars; and either went out of business or turned their efforts to the production of vehicles fitted with internal combustion engines.

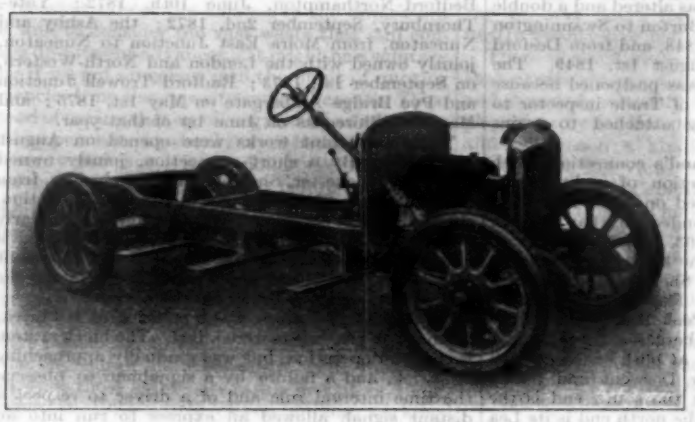


FIG. 11—CHASSIS OF 14-40 H.P. BEARDMORE CAR

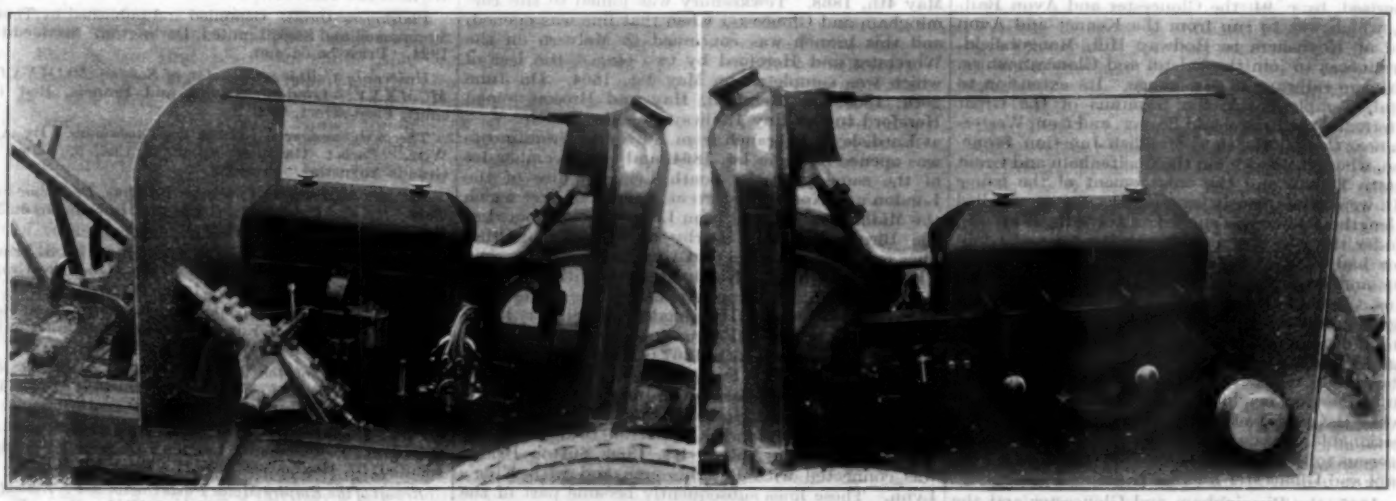
The principal makers of the early steam cars were Americans, and the names of Stanley and White will be still fairly fresh in the memory. Amongst British builders the names of Turner and Clarkson will always be remembered for their pioneer work, in spite of adversities.

The car, which makes its first appearance at the present exhibition, hails from Canada, the builders being Brooks Steam Motors, Limited, of Toronto, who claim for the vehicle neither radical changes nor world-startling innovations. Their efforts have been rather towards the removal of the troublesome features of the steam cars of bygone days. Briefly, the Brooks car consists of a chassis similar to that usually associated with petrol vehicles, its frame, axles, wheels, brakes, and radiator resembling those in everyday use. Its power plant and methods of control alone differ. The power plant consists of a two-cylinder horizontal high-pressure steam engine attached to and forming part of a unit with the rear axle. A vertical fire-tube steam generator designed for a pressure of 500 lb. per square inch is situated under the bonnet, and the radiator acts as a condenser for the exhaust steam. The supply of water to the boiler and steam to the engine is controlled by automatic valves and pumps. The boiler is 20in. diameter and 16in. high and the burners for either petrol, benzole or paraffin are of an improved Bunsen pattern. The engine cylinders are 4in. bore by 4½in. stroke. They are double-acting, with a simple slide valve. All the moving parts are enclosed in an oil bath and the fuel tank has a capacity of 15 gallons, which is said to be sufficient for a distance of from 225 to 300 miles. The weight of the vehicle is 3800 lb. There is an oil separator for dealing with the water of condensation and a water tank holding 21 gallons, which is claimed to be large enough for a run of 450 to 550 miles. An electrical generator for supplying current for the lamps and horn is secured on the back axle and is driven from the main transmission. The control is by means of a hand throttle below the steering wheel, and the engine is reversed by depressing a foot pedal. The body is of the Sedan pattern and made of fabric.

* No. I. appeared October 17th, 1924.

Beardmore.

The firm of W. Beardmore and Co., Limited, is showing for the first time a 14–40 horse-power car with many refinements and improvements which make it suitable for the owner driver. A general view of the chassis is given in Fig. 11, and views of the engine, gear-box and back axle are given in Figs. 12, 13, 14, and 15. The engine is of the four-cylinder vertical type with side-by-side valves and is made of aluminium with cast iron liners. In fact, aluminium is used nearly throughout the power unit to the displacement of cast iron. The first impression given by the appearance of the engine is that of an overhead valve engine, owing to the removable cover on the detachable head. In Fig. 13 will be seen an air pump which is driven by a cross shaft at the front of the engine. This pump serves the double purpose (*a*) of providing pressure to feed fuel from the tank at the rear of the chassis to the carburettor, the latter being fitted high up on the engine in an accessible position; and (*b*) of pumping tires. The magneto, dynamo, water and air pumps are all in accessible positions and the cam shaft is driven by a Renold's silent chain provided with external adjustment to take up stretch. The crank shaft is accurately balanced and is carried in three main bearings not less than 2¼in. diameter. Oil is fed under pressure to all the bearings. To facilitate starting, the Zenith carburetter is provided with a special air strangler, and part of the induction pipe is cast integral with the exhaust manifold, so as to form a "hot spot" to assist carburation and prevent condensation of the petrol vapour. It will be noted that the exhaust pipe is carried forward and away from the floor boards at the front of the car to eliminate excessive heat in the front of the car. Another new feature is the construction of the gear-box,



FIGS. 12 AND 13—ENGINE OF 14-40 H.P. BEARDMORE CAR

Fig. 14, which provides four forward speeds and a reverse, and a special effort has been made to give silent operation of the intermediate gears. The shafts, although short, are carried in three bearings, giving extra support to the constant mesh wheels, which are enclosed in a separate compartment. All the gear wheel teeth are ground. The speedometer drive is taken from the gear-box, and provision is made for the alteration of its gear ratio without dismantling the gear-box in the event of oversize or low-pressure tires being fitted. Four wheel brakes are another new feature. They are of the internal expanding pattern, the Perrot system being used on the front wheels, compensated with the rear wheel brakes in such a manner as to bring the latter into operation first as well as to give a higher pressure on them. In addition to the specially designed front springs and axle necessary for front wheel brakes there is a torque member, the anchorage of which is effected by friction discs forming a combined torque member and rebound snubber. Special attention has been paid to the design of the front wheel braking system to exclude dirt and water as well as to prevent the leakage of oil on to the frictional surfaces. The engine cylinders are 75 mm. by 130 mm. bore and stroke, and the final drive is by means of spiral bevel gears. The clutch is of the single dry plate pattern.

Humber.

Although the Humber Company's exhibits number six, the range of cars on the 1925 programme actually present eleven models, three for the 8–18 horse-power chassis, five for the 12–25 horse-power chassis, and three for the 15–40 horse-power chassis. It should be mentioned that the 12–25 horse-power chassis supersedes the original 11.4 horse-power, with an alteration in cylinder bore from 68 mm. to 69 mm., which increases the maximum brake horse-power

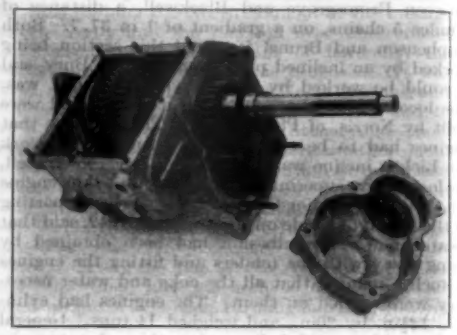


FIG. 14—GEAR-BOX OF BEARDMORE CAR

from 32 to 36. No vital changes have been made from last year's models, but the 8–18 horse-power car has been improved in the matter of chassis lubrication, the grease gun system having been introduced, while the first and second gear ratios have been reduced. To prevent possibility of over-lubrication, the pistons of this model have been re-designed and are now provided with an oil-return groove. There is also fitted an oil pressure filter to prevent dirt being passed by the pump to the working parts.

In this model the crank shaft is now fitted with counterweights similar to those in the 15–40 horse-power model. An important improvement has been effected in the means provided for draining the oil from the crank chamber, the oil drain being operated from the top of the bed-plate. The clutch has been improved, and internal expanding brakes are used instead of external brakes, as hitherto. In the 15–40 horse-power model twin accumulators are provided and supply current to a powerful C.A.V. starter. Front wheel brakes are fitted if required, and are of the Perrot type, with semi-servo type shoes. The increased load due to the fitting of front wheel brakes has been compensated for by strengthening the front axle and stub. The front springs have also been widened, and a cross tube is now fitted between the two front dumb irons. The foot pedal operates the front wheel brakes, together with the transmission brake, and there is a compensating device between the two.

British Thomson-Houston Company.

An extensive range of magnetos, impulse starters, automatic ignition timing gears and car lighting sets is shown on the stand of the British Thomson-Houston Company, Limited, Coventry. The magnetos are of both the rotating armature and polar inductor patterns for any number of cylinders, and embody the

firm's latest improvements. The polar inductor magnetos are of a new design which incorporates a rotary magnetic field and stationary armature. Illustrations of one of these magnetos for six-cylinder engines, and fitted with automatic ignition timing control, are given in Figs. 16, 17 and 18. Several special features are embodied in the designing of these machines. The various components are grouped together into a few accessible sub-assemblies so as to facilitate dismantling whenever necessary and to ensure extreme accuracy in assembly. No special tools are required, and dismantling can be accomplished in a few minutes. The inductors are first pressed on and then secured to a straight-through nickel steel shaft by means of rivets. By this construction the rotary member is of great mechanical strength and is capable of withstanding violent acceleration and deceleration. It is claimed that the magnets, being of cobalt steel, have a very high coercive force, so that the magnetic flux remains stable under the most severe conditions. These magnets, above the main body casting, so as to be out of reach of oil and grease. A wide space is provided for insulation, and in consequence a high factor of safety is obtained. The condenser is mounted on the armature flanges and, like the armature, is out of reach of the injurious effects of oil and grease. An important feature of the condenser is that no rivets are used in its construction, so that the possibility of breakdown in service is reduced to a minimum. The whole armature and condenser assembly can be removed from the armature poles in a few seconds by the simple process of slackening off and throwing back two securing clamps. The entire iron circuit in which the flux reversal occurs is laminated, so as to give a very rapid rise of voltage at break and thus to obtain increased intensity of the spark. The distributor gear wheel, spindle, bearing and distributor brush holder are assembled as a single unit and secured to the distributor end plate by four screws. Integral with the bearing is an oil reservoir so that an adequate supply of oil is always available. Lubrication is carried out by an oil wick and oil ducts in the bearing itself, so that the whole length of the bearing surface may receive the requisite amount of oil. By the provision of a safety spark gap damage to the windings is prevented in the event of one or more of the spark plug leads becoming detached. The high-tension electrode is integral with the distributor brush and the earth electrode is secured to the distributor gear wheel directly opposite to the distributing brush. In operation, the safety spark gap rotates with the distributor gear wheel and is constantly sweeping through the air, an arrangement which, it is claimed, entirely avoids the effects of undue ionisation. The components of the contact breaker are mounted on a base plate which is housed in the lower part of the distributor end plate. The contact lever is provided with a bronze bearing bush which is lubricated by means of an oil wick and a radial hole in the hardened steel bearing pin. The contact breaker is readily accessible after removing the cover and tube, and can very quickly be removed from the magneto for inspection purposes. Special attention has been given to the provision of adequate leakage surface on all the components so as to minimise troubles due to leakage in the magneto itself. The distributor operates with a small gap between the rotating metal distributor brush and the segments.

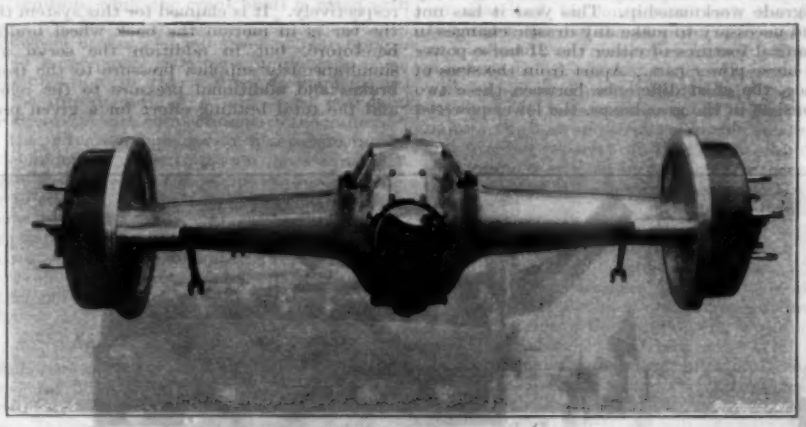


FIG. 15—BACK AXLE OF BEARDMORE 14-40 H.P. CAR

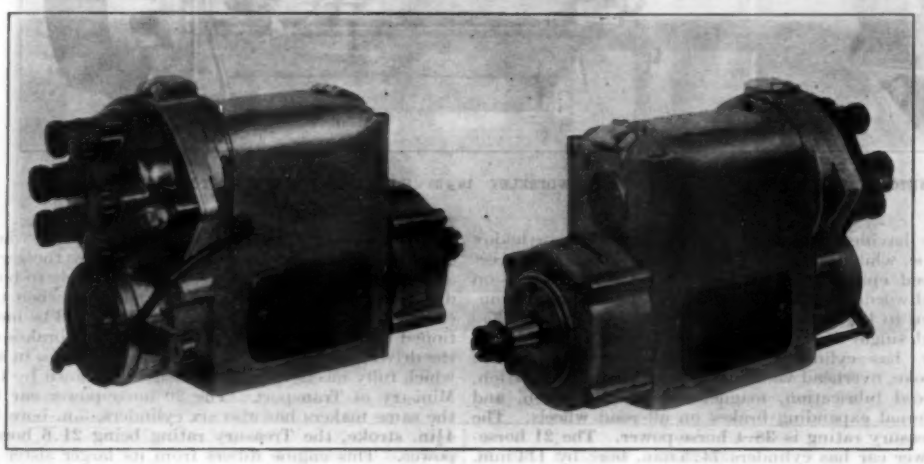


FIG. 16—B.T.H. POLAR INDUCTOR MAGNETO

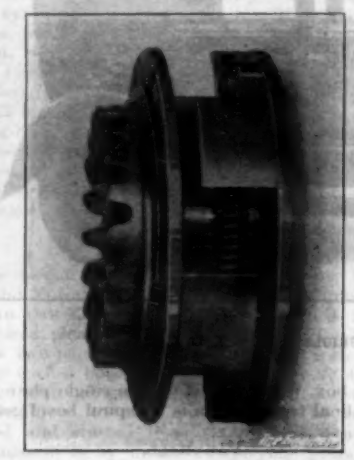


FIG. 17—AUTOMATIC IGNITION TIMING DEVICE

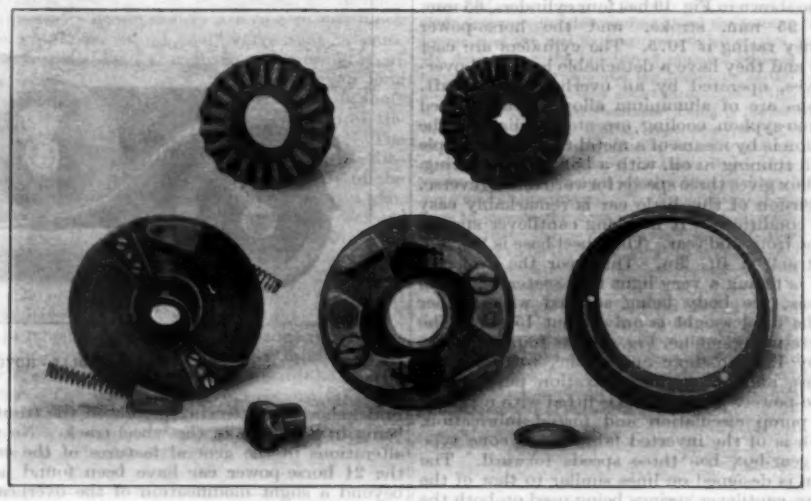


FIG. 18—DETAILS OF AUTOMATIC TIMING DEVICE

The automatic ignition timing device comprises centrifugally operated mechanism which automatically advances the timing of the magneto relative to the engine and at a rate pre-determined in accordance with the requirements of any make of engine. The timing range of the automatic device is 30 deg. The mechanism, Figs. 17 and 18, comprises a driving plate carrying stops and two pawls or weighted levers with a hardened steel roller at one end, the other end being pivoted to the plate, while on the magneto spindle is a driven plate fitted with two hardened steel cams. By means of two strong main control springs connecting the driving and driven plates and a coil spring on each pawl, to eliminate noise at very low speeds by returning the pawls against the cam face, it is assured that, at rest, the stops on the driving and driven members are held radially apart by the tension of the main control springs, and the pawls with rollers in contact with the cams are pressed against the centre boss of the magneto plate. At a pre-determined speed the pawls commence to move outwards under the influence of centrifugal action, which increases the pressure between the rollers and cams, with the results that the speed of the magneto plate is accelerated relatively to that of the driving plate. With increase in speed the pawls move further outwards and the rollers, following the profile of the cams, advance the magnetoly plate relative to the driving plate until, at a pre-determined maximum speed, the two plates are held against the stops and the drive is taken through the plate stops and not through the main control springs, rollers and cams. It will be understood that the speed at which the device begins to operate and the rate at which the magneto plate is advanced relatively to the driving plate can be varied to suit different engines, by varying the tension of the main springs and the profile of the cams.

Sunbeam.

The Sunbeam programme includes three models, namely, the new 12–30 horse-power, the 14–40 horse-power, and the 20–60 horse-power chassis. The two former are four-cylinder models. The 12–30 horse-power—which is not shown—resembles the 14–40 horse-power car in miniature, and has cylinders 68 mm. by 110 mm., with a Treasury rating of 11.46 horse-power. It has overhead valves, forced lubrication, and magneto ignition. The 14–40 horse-power model has an engine with cylinders 75 mm. by 120 mm. and a Treasury rating of 13.9 horse-power. Several improvements have been introduced. The steering is now of the screw and nut type, and embodies unusually large bearing surfaces. The chassis frame is low slung, the rear cantilever springs being attached under the rear axle, and this has brought the car some 2in. nearer to the ground without restricting the ground clearance of the chassis. The radiator is higher, giving almost a straight bonnet line. The track of this model is 4ft. 7in., which is 1in. wider

than hitherto. There is more width in the seats and the touring car has deeper sides, giving additional comfort and an improved appearance to the car. It has also four wheel brakes. The 20–60 horse-power car was first introduced in 1923, and since that time has required few improvements. As in the case of the 14–40 horse-power car, the screw and nut type of steering is now fitted, and the ignition and carburetter controls are particularly neat, being knobs of specially moulded material in place of the usual metal levers. The ignition control is mounted in the centre of the steering wheel, and the carburetter control on the facia board. A minor improvement, but one which will be appreciated particularly by the owner-driver, is the provision of special pads underneath the front axle to provide a secure position for the jack when raising the car for wheel changing, &c.

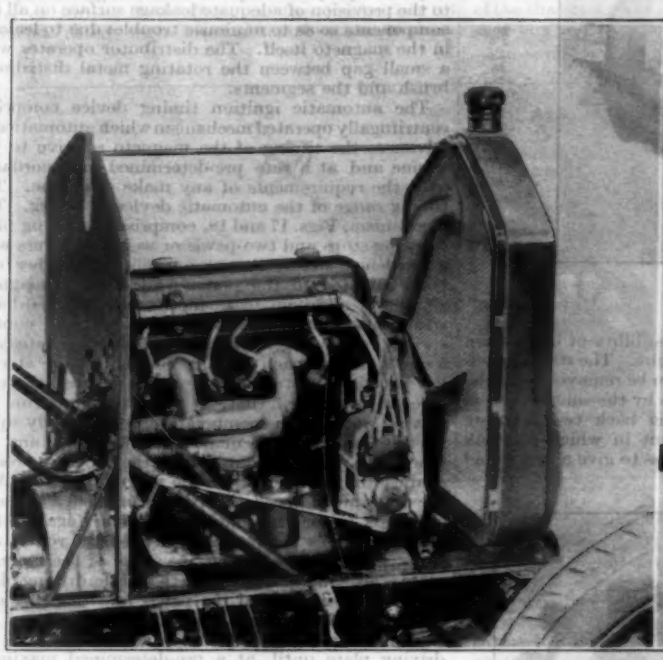


FIG. 19—WOLSELEY 11-22 H.P. ENGINE—MAGNETO SIDE

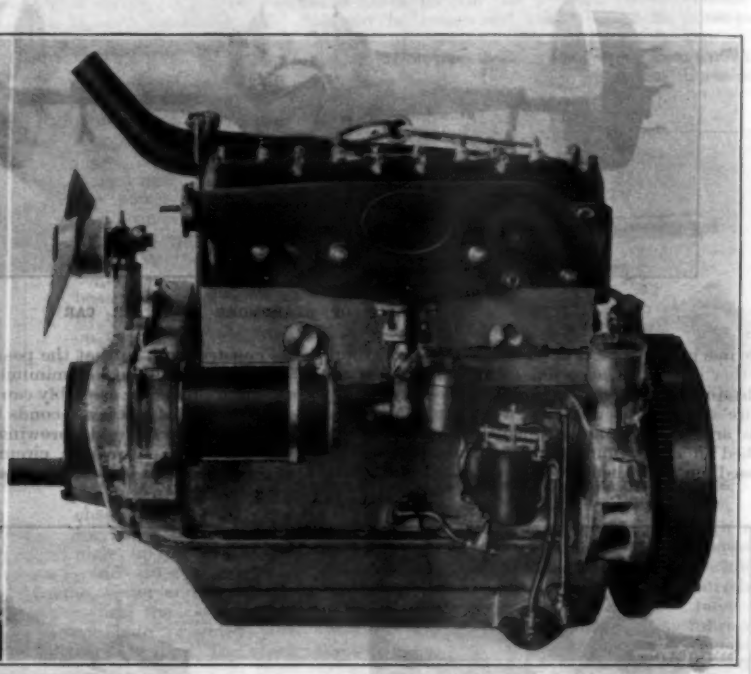


FIG. 20—WOLSELEY 16-35 H.P. ENGINE—CARBURETTOR SIDE

Wolseley.

The Wolseley programme for 1925 comprises the building of three models, namely, the 11–22 horse-power four-cylinders, 16–35 horse-power four cylinders, and the 24–55 horse-power six-cylinder model. The 11–22 horse-power car now supersedes the 10 horse-power machine of last year. With the exception that magneto ignition instead of coil ignition is fitted on all models, the features of this little car are pretty much the same as those of last year's vehicle. The magneto in the 11–22 horse-power engine is driven positively by spiral bevel gears, and is arranged in an accessible position. The oil pump has been improved, and is now self-priming, a non-return valve being also fitted at the lower end of the suction pipe to maintain the pipe full of oil when the engine is at rest. The exhaust jacketed induction pipe is provided with an inspection door to facilitate cleaning. The engine shown in Fig. 19 has four cylinders, 65 mm. bore by 95 mm. stroke, and the horse-power by Treasury rating is 10.5. The cylinders are cast monobloc and they have a detachable head and overhead valves, operated by an overhead cam shaft. The pistons are of aluminium alloy. Gravity feed and thermo-syphon cooling are standardised. The transmission is by means of a metal-to-metal multiple disc clutch running in oil, with a ball thrust bearing. The gear-box gives three speeds forward and a reverse. The suspension of this little car is remarkably easy under all conditions. It has long cantilever springs at both the front and rear. The wheel base is 8ft. 9in. and the track is 4ft. 2in. This year the Wolseley Company is fitting a very light four-seater saloon to this chassis, the body being covered with leather cloth. The total weight is only about 15 cwt. The 16–35 horse-power engine, Fig. 20, has four cylinders, 80 mm. by 130 mm. bore and stroke, with side-by-side valves, and is rated for taxation purposes at 15.6 horse-power. This engine is fitted with magneto ignition, pump circulation and forced lubrication. The clutch is of the inverted fabric lined cone type and the gear-box has three speeds forward. The suspension is designed on lines similar to that of the smaller car, cantilever springs being used on both the front and back axles. Six types of body are fitted. The cam shaft, pump and magneto are all driven by chain gearing. The six-cylinder model is rated at 23.5 horse-power, the bore and stroke of the engine being 80 mm. by 130 mm. The engine has side-by-side valves. The gear-box of this model has four speeds forward and the clutch is of the metal-to-metal multiplate type. Three sets of brakes are fitted, namely, internal enclosed double-acting shoe brakes operating in drums on the hubs of the front wheels, double-hinged strap brake on a drum fitted to the final drive shaft, and internal double-acting shoe brakes on the rear road wheels.

Lanchester.

The name of Lanchester in connection with automobile construction is synonymous with originality and high-grade workmanship. This year it has not been found necessary to make any drastic changes in the mechanical features of either the 21 horse-power or the 40 horse-power cars. Apart from the sizes of the engines, the chief difference between these two models consists in the gear-boxes, the lower-powered car having a four-speed gear-box of the orthodox type, while the higher-powered car retains the three-speed epicyclic gear. Cantilever spring suspension and worm gearing for the final transmission are common to both sizes. Both engines have six cylinders and single disc clutches. The engine of the larger car has cylinders 101.6 mm. bore by 127 mm. stroke, overhead valves, pump for water circulation, forced lubrication, magneto and coil ignition, and internal expanding brakes on all road wheels. The Treasury rating is 38.4 horse-power. The 21 horse-power car has cylinders 74.5 mm. bore by 114 mm. stroke and Treasury rating 21 horse-power. The braking system is of the firm's special design, the brake shoes and steering pivots on the front wheels being in the plane of the wheel track. No material alterations in the general features of the engine of the 21 horse-power car have been found necessary beyond a slight modification of the overhead valve mechanism with the object of lightening the moving parts.

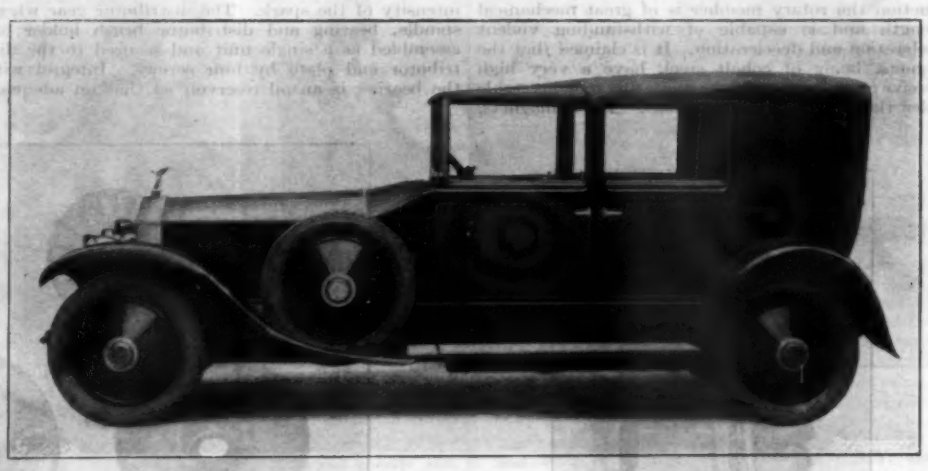


FIG. 21—ROLLS-ROYCE 40-50 H.P. CABRIOLET DE VILLE

Rolls-Royce.

Of the three magnificent cars shown by Rolls-Royce, Limited, two are of the 40–50 horse-power class, Fig. 21, and one of 20 horse-power. The former have cylinders 114 mm. bore by 121 mm. stroke with a Treasury rating of 48.6 horse-power. This is the older model of the two and has side-by-side valves. The Rolls-Royce six brake system is designed on the semi-servo principle, because foot pressure is applied directly to the driving wheels, but the operation causes the mechanical servo apparatus to act and apply the brakes to all four wheels. A floating lever equalising device is fitted to give the correct proportion of braking effect to the back and front wheels respectively. It is claimed for this system that when the car is in motion the back wheel braking is as heretofore, but in addition the servo apparatus simultaneously supplies pressure to the front wheel brakes and additional pressure to the rear brakes, and the total braking effort for a given pressure of the foot is about three times that of either two-wheel or four-wheel brake systems unassisted by the servo apparatus. The servo being driven positively in both directions, the braking is equally effective when the car moves backwards or forwards. It should be mentioned that there are two entirely separate brakes on the driving wheels, so that there are six brakes in all, which fully meets the requirements laid down by the Ministry of Transport. The 20 horse-power car by the same makers has also six cylinders, 3in. bore by 4½in. stroke, the Treasury rating being 21.6 horse-power. This engine differs from its larger sister in having overhead valves, detachable head, and battery ignition. There are three forward speeds in the gear-box, the clutch is of the single plate type, and the final transmission is by spiral bevel gearing.

Vauxhall.

The exhibits of Vauxhall Motors, Limited, comprise five cars on three types of chassis, namely, the 30–98, the 23–60, and the 14–40 horse-power, all of which have been before the public for some time. Very few alterations to the existing models have been found necessary. All the engines are of the four-cylinder type, the largest having cylinders 98 mm. bore by 140 mm. stroke, giving 112 horse-power at 3300 revolutions per minute. This engine has overhead valves, thermostatically controlled water circu-

lation by means of a pump, forced lubrication, magneto ignition, multi-disc clutch, four forward speeds and spiral bevel final drive. The 30–98 horse-power car has a system of four wheel brakes. The 23–60 horse-power car has an engine, 95 mm. bore by 140 mm. stroke, and gives 65 horse-power at 2000 revolutions per minute. This engine has also overhead valves, water circulation similar to the larger car, forced lubrication and magneto ignition, while the crank shaft is fitted with the Lanchester harmonic balancing device. It also has four wheel brakes and independent rear brakes. The 14–40 horse-power cars have undergone some slight modification in the motive mechanism, including the introduction of a four-speed gear-box. Another alteration is in connection with the induction system, the induction pipe giving a separate intake to each cylinder, in order to give a more equal distribution of gas and better conditions for slow running. In order to allow of a more roomy body being fitted, both the wheel base and track have been increased. The bore and stroke of this engine are 75 mm. and 130 mm. respectively, and 40 horse-power is developed at 2400 revolutions per minute. The power is transmitted through a single plate clutch and spiral bevel final drive.

Armstrong-Siddeley.

The fine cars shown by the Armstrong-Siddeley firm consist of 30, 18, and 14 horse-power models. The 30 and 18 horse-power engines have both six cylinders. The only alteration of note to the 30 horse-power engine is the provision of a gear drive for the engine starting motor instead of a clutch. Hydraulic shock absorbers or spring checks are also fitted and a system of four-wheel braking is available. As regards the 18 horse-power car, the most noteworthy alteration since last year is in connection with the clutch, which is now a single dry plate instead of the multiplate metal and fibre clutch, which has given such good service hitherto. Another slight modification in the 18 horse-power car is an increase in the width of the wheel track to 54in., which enables a slightly wider body to be fitted. Low-pressure tires and four-wheel brakes can also be fitted. The 14 horse-power chassis is shown fitted with a saloon landaulette and open touring bodies. It is a remarkable production as regards value for money. The engine has four cylinders, 3in. bore by 4in. stroke, overhead valves, pump circulation for the water, forced lubrication, magneto ignition, three speeds, and spiral bevel final drive. Fitted with a saloon body it makes an ideal family car for persons of moderate means. Fig. 22 is an illustration of the 30 horse-power Armstrong-Siddeley six-cylinder enclosed limousine. This is a seven-seater car, the main seats being supplemented by two upholstered folding chairs. It has four doors and a partition between the driver's and passengers' seats.

Trojan.

The special features of the Trojan car, built by Leyland Motors, Limited, have been previously dealt with in The Engineer. It is claimed to be the only solid-tired pleasure vehicle in the world. This car has a two-pair two-stroke horizontal water-cooled engine with a bore and stroke of 2⅝in. by 4⅜in. It is fitted with coil ignition, and the petrol consumption is only about 40 miles per gallon. The engine is primed and started from the driver's seat. The transmission is by means of epicyclic gears, giving two forward speeds and a reverse. There are two independent brakes, one acting on the transmission and the other on the rear axle. There is no differential gear, and the final drive is by means of a duplex silent chain. A special feature of this cheap little car is the method of suspension by means of very long cantilever springs, which give very comfortable riding over bad roads. A detachable key, fitting a socket on the dashboard, acts as a master switch to the electric horn and ignition circuits, in addition to turning on either the main or the reserve petrol supply. Its removal provides an effective thief-proof device. The tail lamp is totally enclosed, but is visible to the driver through a tell-tale.

Bean.

A. Harper, Sons and Bean, Limited, are represented by two types of chassis, the 14 horse-power, which we described in connection with the Exhibition, and which, beyond the adoption of front wheel brakes and balloon tires, remains unaltered. This year, the company is introducing a new 12 horse-power car, with a four-cylinder monobloc engine, which develops 24 horse-power at 2400 revolutions per minute, the bore and stroke being 69 mm. and 120 mm. and a cubic capacity of 1794 c.cm. Lubrication of this engine is effected by pressure, by means of a gear pump through a hollow crank shaft to the main cam shaft and big end bearings. The ignition is by high-tension magneto. The engine is cooled on the thermo-syphon system assisted by a high-speed fan driven by an enclosed adjustable silent chain. The clutch has three plates alternately steel and Ferodo, running dry. The gear-box provides four speeds forward, and is bolted direct to the bell housing containing the fly-wheel and clutch. The rear axle is of the three-quarter floating under-slung type, and the final drive is by spiral bevel gearing. The transmission from the gear-box to the rear axle is by means of a tubular propeller shaft with an interchangeable universal joint of the sliding block type at either end. Brakes are provided on all the four wheels.

Chrysler.

Much has recently been heard through the medium of the daily Press of the merits of the new Chrysler car. In the design and construction of this car is said to be incorporated the wide experience of several of the foremost automobile engineers in the United States. The result, as far as we could gather from an external inspection, is a car superior to the average American products, but at a higher price. The engine has six cylinders, with a bore and stroke of 3in. and 4½in. respectively, and for taxation purposes is rated at 21.6 horse-power; but is claimed to develop 68 horse-power. The cylinders are cast in one block with the crank case, and each valve seat is completely surrounded by water space. The crank shaft is machined all over, and is carried in seven long bearings. Through drilled passages in the crank shaft oil under pressure is carried directly to each of the bronze backed babbitt-lined main bearings. The valves, of the side-by-side variety, are $1^{7}/_{16}$in. diameter, and the pistons are of aluminium alloy of the slotted type, with three rings above the piston pin. The connecting-rods are drop forgings of I section, 10in. long and the big end bearings are 1⅞in. long. There is nothing further of special note in the engine. The transmission system comprises a dry plate multiple disc clutch, three speed gear-box, and spiral bevel final drive to a semi-floating rear axle, contained in a banjo housing. A thermostatic control valve is placed in the cylinder head water outlet, and a centrifugal air cleaner is fitted on the air intake of the carburetter. The brakes on all wheels are operated by pedals through a hydraulic system. The finish of the bodywork compares very fairly with that of British cars of a similar class.

FIG. 22—ARMSTRONG-SIDDELEY 30 H.P. ENCLOSED LIMOUSINE

A LARGE GRAIN ELEVATOR.

The new No. 3 grain elevator of the Montreal Harbour Commission at Maisoneuve has been completed and is now in operation. It has a storage capacity of 2,000,000 bushels and a working capacity of 10,000,000 bushels, provision having been made for a further expansion of the storage by 8,000,000 bushels, which would make it the largest elevator in the world. The cost is estimated at 3,000,000 dollars. It is constructed on an entirely new design, with a special view to light and ventilation throughout, including the basements, thereby lessening the risk of explosion. Four car dumpers by which the grain is lifted and passed to a belt conveyor are able to deal with 600,000 bushels per day, and four marine towers can unload a similar amount from the lake boats, giving a total unloading capacity of 1,200,000 bushels per day. The grain is stored in 27 bins. After the grain is elevated it is weighed in enormous scale hoppers, each capable of holding 75 tons and distributed to the storage bins by a system enabling it to be shifted from any hopper along the conveyors to any bin merely by the moving of a lever. There are five shipping berths allowing as many vessels to be loaded at the same time. In all there are 16 miles of conveyor belting for the shifting of grain and 10 miles of elevator casing and spouts.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

WORK HARDENING OF HARDENED STEEL.

Sir,—In commenting on Dr. Hultgren's discovery that hard steel balls can be super-hardened by cold working them under heavy loads, you did well to point out its significance, particularly in its bearing on the theory of hardness. You may be interested to have a brief description of an independent investigation on this subject.

Some months ago I was engaged in determining the effect of temperature on the hardness of very hard tool steel. A piece of an old file was taken as the subject for a preliminary investigation. Time tests were made with the pendulum hardness tester, fitted in this case with a homi-spherical diamond point of 1 millimetre diameter in place of the steel ball, which had been found incapable of withstanding the combined effects of pressure and high temperature. The specimen was placed in an electric furnace, which was so constructed that tests could be carried out at any desired temperature and without removing the specimen from the furnace.

It occurred to me to try a "work hardening test," and I was surprised to find that a very pronounced and progressive increase of hardness was shown by the scale readings as a result of repeated rolling with the spherical surface of the diamond. On the cold steel the first scale reading was 60, and the average of the four subsequent readings was 92, the difference between these figures representing the average increase of hardness due to rolling the hardened steel four times with the diamond. The progressive hardening was similar in character and in amount to that produced in mild steel by the rolling action of the steel ball of the pendulum.

This result was so interesting that the work hardening tests were repeated *pari passu* with the time hardness tests throughout the range of temperature from cold to 400 deg. Cent. The complete time hardness, scale hardness, and work hardening curves of the steel present striking features whose full significance is not yet understood, and it is proposed to publish them. It was thought at the time that the work hardening of hard steel by rolling it with a diamond could possess little beyond academic interest, though there seemed a possibility that a further study of this phenomenon might throw light on the general subject of work hardening. Dr. Hultgren's announcement of his independent discovery of super-hardening placed the matter in a very different light. Here was at once a practical application and others might follow.

It should be noted that the work hardening shown by Dr. Hultgren's process was much less than that indicated by the pendulum work-hardening tests; but, on the other hand, the deformation produced by the diamond ball was much greater than would be permissible in the hardening of steel balls by cold work. The diamond produced an elongated indentation easily visible to the naked eye.

Edward G. Herbert.

Manchester, October 19th.

FATIGUE IN THE IRON AND STEEL TRADES.

Sir,—In your reply to my letter on this subject, which was published in your issue of October 3rd, you rightly suggest that there is some misunderstanding about the fettling times quoted by me, and the real fettling times to which you yourself refer. My data record the number of minutes elapsing between the tapping of the furnace and the beginning of the fresh charge, and I point out that only about three-fifths of this time is spent in actual fettling, the remainder being occupied by hardening the furnace bottom. The average time quoted by you for the interval observed at one works, viz., 100 minutes, corresponds closely with the average of the times observed by me at seven works—viz., 102 minutes—if the long fettlings lasting ten or more hours are excluded. Your contention that no firm could hope to operate the open-hearth process successfully when the fettling times—as quoted by me—averaged three hours does not appear to be borne out by actual experience, for the works at which the data were obtained belongs to a very large and well established firm.

Again, you rightly point out that it is dangerous to apply to the whole industry conclusions drawn from the practice of only a small number of firms, but may I remind you that my inquiry was a somewhat comprehensive one, as at the suggestion of my committee I visited many of the largest and best equipped iron and steel works in England, Scotland, and Wales, and collected statistical data at sixteen of them.

H. M. Vernon.

Oxford, October 17th.

100 YEARS OF BRITISH RAILWAYS.

Sir,—In the last issue of The Engineer, under the above heading, you state that Francis Fox, chief engineer of the Bristol and Exeter Railway, was father of Sir Francis and Sir Douglas Fox. This is incorrect. My uncle, Francis Fox, became chief engineer of the Bristol and Exeter Railway in 1854, and was no relation to either Sir Douglas or Sir Francis Fox. I thought perhaps you might like to make this clear to your readers.

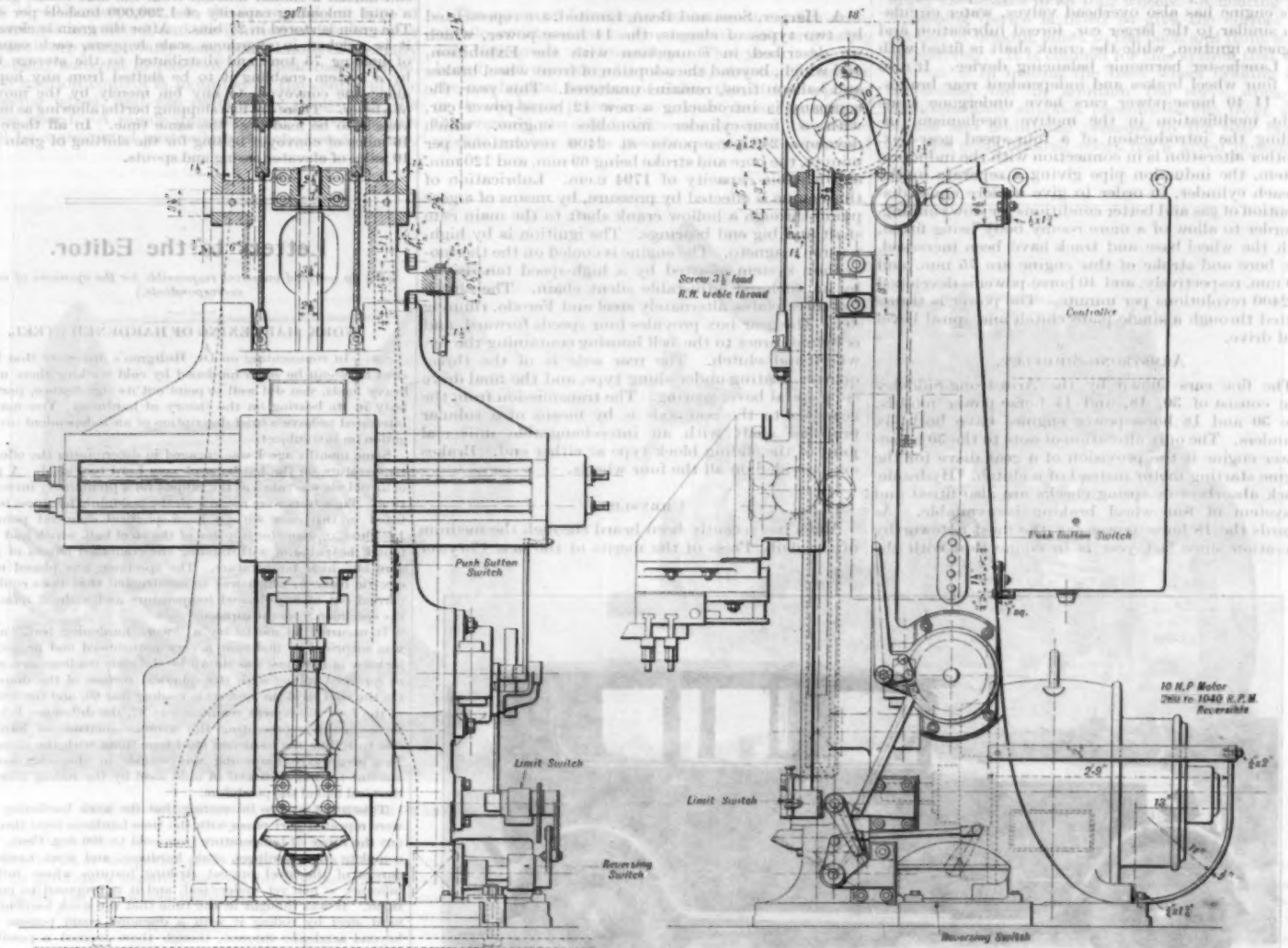
Frederick M. Jones.

Weymouth, October 16th.

48-INCH STROKE PORTABLE SLOTTING MACHINE

HULSE AND CO., LIMITED, SALFORD, MANCHESTER, ENGINEERS

(For description see opposite page.)



New Storm Relief Sewer for London.

THE scheme for the relief of floodings in various parts of the metropolis, which was submitted to the London County Council by its Main Drainage Committee in July, 1919, provided for the construction of a sewer from Kilburn to Hammersmith in order to relieve floodings in Willesden, Paddington and North Kensington. The greater part of that area is at present drained by the Ranelagh sewer, which is at times heavily surcharged. Although this sewer is a large one—8ft. in diameter—and is capable of discharging a fairly heavy rainfall direct to the river Thames by means of the Ranelagh storm relief sewer, into which it overflows at Hyde Park, some relief is necessary as floodings, when they occur, are severe. The drainage of other parts of the high level area in the north-west of London discharges into the lower areas where it greatly aggravates the surcharging of sewers and where also it has to be pumped.

The Willesden Urban District Council and the Hampstead Metropolitan Borough Council have repeatedly directed attention to floodings which have occurred in the areas under their respective control, and they have urged that the Ranelagh sewer where it passes under the London and North-Western Railway near Kilburn Station should be enlarged. At this point the sewer is somewhat reduced in size. The Main Drainage Committee, in a report made recently, states that it is advised that the effect of carrying out the suggestion made by these authorities to enlarge the Ranelagh sewer would not be desirable and would tend to transfer the floodings to a point further down the course of the sewer. The committee further reports that the proposed new sewer should relieve the floodings of which the two authorities complain, and that it will also improve conditions in other districts draining into the Ranelagh sewer, and, what is of great importance, cut off part of the storm water from the low-level areas.

The works comprise the construction of the principal sewer which will be connected with the Ranelagh sewer in Shirland-road, Kilburn, and will run to the nearest point on the river Thames, at Hammersmith, connecting with various main sewers on the way. Branch sewers will be constructed to connect the new sewer with the middle level sewer in Ladbroke-grove, and with the Wood-lane sewer at Wormwood Scrubbs. A connection will also be made with the new pumping station at Hammersmith. Altogether the construction of about 5½ miles of sewer is involved. The sizes of the sewer and branches will vary from 4ft. to 9ft. 6in. in diameter, increasing towards the outlet to the river.

It would be difficult to say when the work would have been put in hand had present-day conditions been normal, but it is now proposed to begin it and, in common with other main drainage works, the sewer is considered to be very suitable for the provision of additional employment. It has been approved for the purpose of State aid by the Unemployment Grants Committee, subject to work being commenced by January 1st, 1925. To this end the preliminary work involved in the preparation of drawings and specification has been pressed on and tenders will be invited at the earliest possible moment. The estimated cost of the work, including expenditure, not provided for in the contracts, amounts to £527,000. The work will occupy about 2½ years and the expenditure will, it is anticipated, be incurred as follows—financial year 1924–5, £30,000; 1925–6, £200,000; 1926–7, £200,000; 1927–8, £97,000.

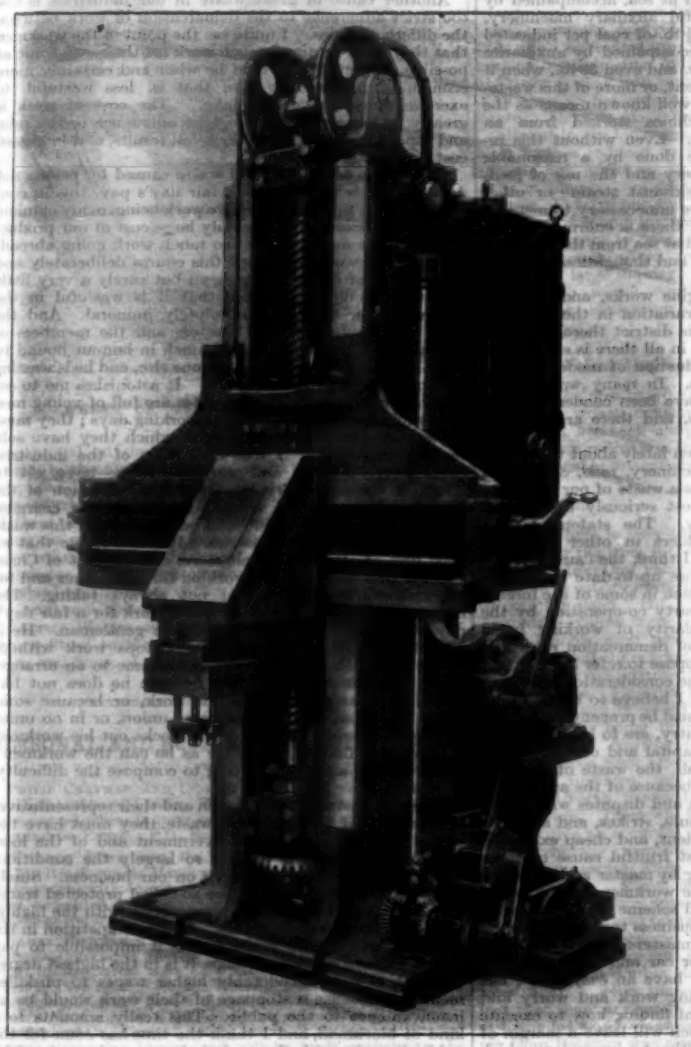
SIXTY YEARS AGO.

SOME early information regarding the economy to be secured by the adoption of superheating in marine steam engines is to be found in our issue of October 21st, 1864, in the course of a paper which Mr. James R. Napier had read before the Institution of Engineers in Scotland, and which we reprinted together with the discussion thereon. Mr. Napier's paper was stated to have been compiled "from data supplied chiefly by Mr. William Beardmore." Exact judgment of the true value of superheating was made difficult, in fact, almost, impossible, because in the instances quoted the change from non-superheated to superheated steam was accompanied by certain additional changes of an irrelevant nature, such as the installation of different types and sizes of boilers and the replacement of fixed paddle wheels by paddles of the "oscillating" type of the same or reduced diameter. Even allowing a considerable improvement in efficiency to follow from these additional changes, it was generally admitted in the paper and the discussion that superheating saved fuel and increased speed. In a clear case not complicated by other changes, a paddle steamer, the Caledonia, of 220 nominal horse-power, after conversion to superheating reduced, it was reported, her coal consumption on the voyage between London and Granton from 126 tons to 90 tons, and, in addition, saved about an hour on the average passage. In another case, that of a small vessel, the Concordia, a change from fixed paddles, non-superheating, to oscillating paddles and superheating resulted in an increased speed of 16 per cent., and a decreased coal consumption of 41.6 per cent. The oscillating paddle, we presume, is to be identified with the paddle wheel having feathering blades, as distinct from the earlier type possessing fixed radial blades. . . . . In the course of a lengthy article on the powder magazines at Purfleet—a subject of popular interest and, apparently, of some excitement, at the moment, in view of a disaster to a barge loaded with 50 tons of gunpowder off Erith—it was revealed that at Purfleet storage was provided for 52,000 barrels, or 2300 tons of powder. The magazine was then a century old, and some of the barrels in which the powder was stored had been in use since 1808 and 1813. Apart, however, from the fact that powder testing was carried out at the magazines, there was, it seems, little to excite apprehension. The control and management of the establishment were, in fact, or so it can be inferred, as close and thorough as in the case of a modern establishment of the same nature. Nevertheless, an effort was made to estimate what effect a disaster to the magazines would have on London. By very simple arithmetic it was sought to show that the explosion of 2000 tons of gunpowder at Purfleet would produce a shock of some 3 lb. per square yard on the surface of London's buildings, a force "probably sufficient to break most windows facing in the direction of Purfleet." Gravesend and Woolwich, it was added, would probably be completely unroofed and Erith would vanish into air. It may perhaps be added that when 40 tons of high explosive blew up at Silvertown in 1917 much of the damage elsewhere than in the immediate vicinity was done on the "sheltered" sides of houses, and relatively little on the facing sides. . . . In a paragraph in the same issue, we recorded the information that Mr. T. F. Fillary, of London, had been awarded a premium of £25 by the Middlesex visiting justices "for the most approved design for their new set of treadwheels for working 160 men at one time."

THE Ministry of Transport's railway statistics for July last, recently issued as a Stationery Office publication, make good reading. They show that, compared with the corresponding month of 1923, there was an increase of 4.3 per cent. in the tonnage. Only in coal, coke and patent fuel was there a decrease, and that of but 1.1 per cent. General merchandise rose by 15.5 per cent., and other minerals by 11.9 per cent. Iron and steel were greater by 10.2 per cent., grain by 34 per cent., timber by 14.7 per cent., and bricks by 18.7 per cent. The stone for road-making—23 per cent. more—was the highest quantity recorded since the statistics were begun in January, 1920. The total freight receipts were 2.8 per cent. higher, but it has to be remembered in this relation that rates were reduced in August, 1923, and so in that respect the two periods were hardly comparable. This extra traffic, however, necessitated 5.5 per cent. more freight train miles, and, moreover, the loading per train was higher—an average of 128½ tons, as compared with 125½ tons in 1923.

48in. Stroke Portable Slotting Machine.

For dealing with large castings, especially where the surfaces to be machined occur on more than one side, portable machines have certain advantages. The capital cost involved is comparatively small and a good deal of the handling and setting of heavy masses can be avoided, the machine being easily moved into position for machining the various faces. The adoption of portable tools, particularly reciprocating machines, has, however, been somewhat restricted hitherto by their lack of rigidity and power, but Hulse and Co., Limited, Salford, Manchester, the makers, claim that these disadvantages have been removed in the portable slotting machine recently supplied by them to an English manufacturer of large steam units. The machine, which is illustrated below and on the opposite page, is driven by a direct-coupled 10 horse-power direct-current reversing electric motor. The motor and contactor switchgear are arranged as a complete unit with the machine, the only external fixture being an isolating switch. From the general view it will be seen that the upright frame is of box form with stiffening ribs, and the lower edges are planed to facilitate setting



48-INCH STROKE PORTABLE SLOTTING MACHINE

square with the base-plate slots or with another surface. The cross slide is counterbalanced by a weight moving in guides within the upright frame. The two connecting wire ropes are arranged so that the load is equally balanced between them, and yet in the event of one breaking the other will support the weight.

The cross slide is fitted with a strong tool-box with a swivel and relieving motion, which has self-acting and hand feeds in the longitudinal and transverse directions. These feeds are controlled from the end of the cross slide. The principal slides are fitted with taper wedge strips. The main driving screw has a quick lead and rotates in gun-metal adjustable bearings, one of which is made with multiple surfaces for taking the end thrust. These bearings are arranged so that the screw can be taken out for inspection without removing the cross slide. The screw is driven by double helical and spiral bevel wheels housed in the base of the machine.

The operation of the machine is reversed by stops on a rotating disc geared to the main screw. The cutting and return speed can be varied from 20ft. to 80ft. per minute by means of the hand wheels, which may be seen on the control panel, whilst a push button control allows for "inching." All the controls are brought to one side and can be manipulated from a convenient position. The maximum distance from the tool to the floor line is 4ft. 9in. and the minimum distance 9in. The stroke is 4ft., the longitudinal traverse of the tool-box or angle slide is 4ft., and the transverse movement of the tool-box 9in. The machine is provided with a lifting shackle at the top to enable it to be moved about easily.

Bulk Electricity Tariff in South Africa.

In the course of a paper on "Power Supply to the Rand," recently read before the South African Institution of Engineers, Mr. Otley compared the Victoria Falls Power Company's mining tariff with that of one of the largest power concerns in the world, namely, the Pacific Gas and Electric Company, operating in California. The latter concern had a sales output of 1726 million units in the year 1923, that is to say, nearly double that of the Rand power companies. The major part of its output is generated by water power, and consequently, Mr. Otley argued, the running cost per unit should be very low, and its standing charges, including capital, should form the principal factor in its charges per unit. As the Rand Power Company is controlled by, and its charges are subject to the approval of, the Control Board under the Electricity Act, so the charges of the Pacific Gas and Electricity Company are controlled by a Commission in the State of California.

As a matter of interest, Mr. Otley said that he had worked out for a typical mine supplied by the Power Company, the price it would pay at the California rates. For the mine in question the maximum demand is 5250 kilowatts on the one hour's demand, the consumption per month is about 2,610,000 units, and the load factor 69 per cent. On the California tariff the price paid would be about .400d. per unit, which is slightly less than the price which will be paid by the mine in question to the Victoria Falls Company.

Another example for a Witwatersrand mine, the maximum demand of which was about 1600 kilowatts and the monthly consumption about 750,000 units, worked out at .42d. on the California rates, and about .45d. on the Power Company's tariff. Evidently, remarked Mr. Otley, the Power Company's rates are low, when it is borne in mind that the whole of the power is generated by steam and that the capital costs of erecting plant in South Africa are considerably higher than elsewhere, and also bearing in mind that the California system is a very large one, having nearly double the output of the Rand power companies, and that the bulk, if not the whole, of its power is water generated.

When the big power station, the erection of which has just been started at Witbank, right up against the collieries of that district, is completed, it will be supplying electricity in bulk at prices which will compare favourably with those of any part of the world. During 1923 the Vereeniging power station — Victoria Falls Power Company — sent out 326.34 millions of units and 476,000 tons of low-value coal were burnt. The coal cost about 2s. 6d. at the pit's mouth, and the railage amounted to 19d. per ton. The Witbank power station is to obtain its coal at 1s. 0d. per ton for twenty years, and there will be practically no haulage, so that, irrespective of any economy which will accrue from the installation being the very latest in every respect, there will be a considerable saving on the cost of coal. The engineers to the Witbank power station, in fact, contemplate unit charges going well under a half-penny. As the result of negotiations with the mines of the Rand, an agreement has been come to whereby, excepting only the mines supplied by the East Rand Proprietary Mines, Randfontein and the Kleinfontein power stations, the group has contracted to take its supply of electrical energy from the power company for the life of the various mines or for twenty years, whichever is the longer. This contract is the largest supply contract ever negotiated, and the terms are such that electrical energy will be delivered to the mines at a price of approximately .44d. per unit, and, in addition, the groups will participate in the surplus profits of the Power Company after certain reservations are made for a reasonable return on the capital embarked in the business. The tariff is framed on a basis of a charge per kilowatt per month, plus a charge per unit consumed, but the group has the benefit of diversity as between its own mines, and, in addition, the maximum demand is not based on the actual annual peak, as is usual, but on the monthly maximum demand, this demand being the actual maximum number of units taken in any one hour during that month.

Coal has been proved under Hatfield Moor, near Doncaster, and a new pit is to be sunk there by the South Hetton Coal Company.

The Discoveries of the Darbys of Coalbrookdale.*

By T. S. ASHTON, M.A., Manchester University.

One of the most curious things in the history of technical discovery is the obscurity which has surrounded the origin of the practice of smelting ironstone with mineral fuel; and, even to-day, there is by no means unanimity as to the time and circumstances of the discovery.

In the first place, writers who ought to know better have accepted at its face value the claim of Dud Dudley to have smelted and fined iron with pit coal as early as 1620. The few facts that are known of Dud Dudley's life show him to have been of an excessively assertive and untrustworthy disposition; and, until evidence from other sources is forthcoming, we shall do well to regard the assertions made in "Mettallum Martis" with at least the same degree of scepticism as we accord to the claims of other courtly projectors of the Stuart period.

In the second place, those who have recognised that Coalbrookdale is the true home of the discovery have left obscure the identity of the discoverer, for whereas Scrivenor attributed the process to the first Abraham Darby in 1713, later writers have followed Dr. Percy in giving the credit to the second Abraham Darby, and have dated the origin of it variously between 1730 and 1740. It is the object of this note to throw light on this disputed point.

Preserved in the works at Coalbrookdale is a Day Book kept by the first Darby from the very earliest days of the concern. Containing some forty or fifty folios, it yields much interesting information concerning the beginnings of the firm. It is clear, for example, that Abraham Darby had left Bristol for Coalbrookdale in 1708, and during this year he was busy equipping and reconstituting the newly acquired works; in 1709 he was receiving tools and utensils from the Bristol Ironworks, and was sending thither pig iron castings produced at Coalbrookdale.

But the entries of greatest interest are those relating to the purchase of coal from Richard Hartshorn, a master collier of Little Wenlock. The following (under various dates) in the year 1709, are given by way of example:—

	£	s.	d.
Richard Hartshorn & Co.			
By Cash pd. E. Dorrell pr. theyer order in part for Coles		8-	04-06
By Cash pd Edward Dorall for coles		05-	16-11
R. Hartshorn			
By Cash paid Dorrall for Getting Coles by theyer order		11-	19-06
Richard Hartshorn		20-	00-00
Pd. Richard Hartshorn pr.			
William Garbit for Getting Coles		03-	19-00
Ditto. pd. Edw. Dorall		05-	16-04

For what purpose was this coal obtained? A very small proportion of the whole perhaps for household use and some for a preliminary calcination of the ironstone. But it appears highly probable that much, if not all, of it was converted into coke and used—whether alone or along with charcoal—in the blast-furnace itself. It may be conjectured that the following entry relates to the coking of the fuel for this purpose:—

	£	s.	d.
By cash pd for Charcking Coles		00.	01. 03

And though the word "coles" was used at this period for both charcoal and pit coals, it is probably safe to assume that it is the latter that is the subject of yet another entry:

Lawrence Woling			
By cash pd. him in part for Coles and Iron Wheald ye first blast	30.	-00	-00

Hence we have good reason to believe that it was the first Darby, and not his son, to whom the honour should be assigned; and we are confirmed in this belief by the testimony of the wife of the second Darby.

There is in the possession of Mr. Darby, of Shrewsbury, a letter written by this lady to a friend, shortly after the death of her husband, setting forth the main facts of his life and works. Had the second Abraham really been the originator of the coke process his widow would surely have known of it and would have mentioned it in this letter. Not only does she make no claim of this kind, but she expressly attributes the discovery to her husband's father, Abraham Darby, the first†, and we have shown grounds for thinking that this was made at least as early as the year 1709.

How, then, it may be asked, did the confusion arise? In the year 1864 the wife of a Darby gave to Dr. Percy a picturesque account of the discovery, according to which, after a week's vigil at the furnace, the second Abraham Darby succeeded in smelting iron with coke. In view of the evidence submitted above it would appear that the lady had confounded the generations, and most modern writers have been led astray by her story. One, indeed—the writer of the articles on the Darbys in the "Dictionary of National Biography"—has attempted to reconcile the two accounts by suggesting that the father discovered the process, but that, on his death, it was forgotten and had to be rediscovered by the son—a most improbable hypothesis.

The absence of contemporary comment on the discovery is to be explained partly by the Quaker reticence of the first Darby, partly by the position he occupied in the iron industry of his day. It is necessary to remember that Abraham Darby was, first and last, a founder; he had studied the process of casting in Holland, had conducted a brass and ironfoundry in Bristol, and, with the help of his servant, John Thomas, had devised and patented, in April, 1707, the process of casting "iron-bellied pots . . . in sand only without loam or clay." At this time castings were made direct from the blast-furnace and there were many defects in the metal; so that it was only rough commodities like garden rollers, grave slabs, fire-backs, pipes, and pots that could be successfully produced. Hence cast iron played but a subordinate part in industry during the early eighteenth century; fully 90 per cent. of the activities of the ironmasters were given to the production of malleable

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* Newcomen Society, general meeting, October 8th, 1924.

† The letter is printed *in extenso* in a forthcoming volume by the present writer, entitled "Iron and Steel in the Industrial Revolution" (Manchester University Press).

iron for the use of smiths and metal workers; and since, at first, the coke-smelted pig iron was deemed unsuitable for conversion into bar iron, many who knew of the new process may have thought it to be of small moment.

This backwardness of the casting branch of the industry, before the days of the Darbys, was due to a technical defect of charcoal; the danger of crushing the charcoal set a limit to the weight of the charge, and the height of the furnace, and the metal left it in a viscous rather than a liquid flow. The exact nature of the discovery itself has never been made clear; coke had long been known and used in other industries. It would appear, however, that the clod coal of Shropshire produced a coke peculiarly suited to the smelting of iron, and that the possession of a high furnace and strong bellows enabled Darby to obtain a metal that flowed more freely into the interstices of his moulds than that drawn from the charcoal furnaces of his day.

During the lifetime of the first Abraham, then, the new process was confined to this subordinate foundry branch of the industry. It was the second Abraham Darby who extended the use of coke-smelted pig iron to the more important malleable iron branch. "About 26 years ago" (wrote his widow in the letter to which reference is made above) "my Husband conceived this happy thought—that it might be possible to make bar from pit coal pigs. Upon this he sent some of our pigs to be tryed at the forges, and that no prejudice might arise against them he did not discover from whence they came, or of what quality they were. And a good account being given of their working, he erected Blast furnaces for Pig Iron for Forges. Edward Knight Esqr a capital Iron Master urged my Husband to get a patent, that he might reap the benefit for years of this happy discovery: but he would not deprive the public of such an Acquisition which he was satisfyed it would be; and so it has proved, for it soon spread, and many furnaces both in this Neighbourhood and several other places have been errected for this purpose."

Perhaps it should be made clear that this process of making bar iron from coke pig iron was itself carried out with charcoal; it was not until the days of the Cranage brothers that coke was used here.

Let us repeat: the first Darby used coke in place of charcoal in the production of castings; his son converted this coke-smelted iron into malleable iron with charcoal; the Cranages and Henry Cort substituted coke for charcoal in this final process. By so doing they broke the last shackle binding the industry to the woodlands, and enabled it to renew its youth on the coalfields of the Midlands, Yorkshire, and South Wales. The work begun by Abraham Darby in 1709 was completed by Henry Cort in 1784.

Waste.*

By TOM WESTGARTH, Fellow.

We are continually struggling after improvements in our operations, and trying to bring the great forces of Nature more and more into our service, but it may be that we sometimes overlook the losses and wastages which take place. Undeniably immense strides have been made in the economical generation of power from the resources which Nature has placed at our disposal, but how much we waste! Consider how large a percentage of the energy in coal, in oil, and in water power we lose, that is, waste. If we reflect that in the most highly developed Diesel engine only about one-third of the energy in the fuel oil is converted into useful work, that in a modern steam turbine plant using superheated steam at high pressure and with the almost perfect vacuum now obtainable, the result is less, that is to say, the waste is more, and that with a high-class reciprocating steam engine, under the same conditions, the waste is still greater, we must agree that notwithstanding all our modern improvements there is a terrible waste of Nature's forces; and I am afraid it is the same in most of our manufacturing processes.

I will take as an example a blast-furnace plant, not because such works are more wasteful than others—indeed, many of them are remarkable for the full development of methods to prevent waste—but because a blast-furnace affords such a good example of what may be done in waste prevention. We have from our blast-furnaces and accompanying coke ovens great volumes of gases generally known as "waste gases"—the term should often be "wasted gases"—which contain very large sources of power and valuable by-products. For the most part the by-products are now recovered and form an important source of revenue; but in many of our furnaces the gases are wastefully used so that they are all consumed to drive the plant, whereas by cleaning the gases before they go to the hot blast stoves, and by further cleaning part of the remainder and using it in gas engines for driving the blowing engines and electric generating machinery of the works, there should be a surplus of gas for generating electric energy which could be used in the accompanying steel works or sold to adjoining works or to the public. In any blast-furnace plant using coke fuel and ordinary ores there is great waste if the gases are not so used. No other fuel than the furnace coke should be required; there should be no boilers, and there should be a large surplus of gas for use outside the blast-furnace plant. These considerations are fulfilled in the up-to-date plants in this country, and in practically all those in America and on the Continent; and yet in this country there are still a great many blast-furnaces using—that is wasting—all their gases, and even sometimes using coal under their boilers in addition. A visit to the blast-furnace works abroad compels one to acknowledge how far behind-hand are many of the similar works in Great Britain; and it seems that to enable us to compete in the world's markets many of our works must be reorganised and largely rebuilt. This kind of work would appear to be a much more sensible use of the nation's capital and the Government's backing than lending money to our competitors, especially to those who will not promise to repay the loans or even to guarantee the interest. But it would be of little use—indeed, it would be waste of money—to spend the capital that is necessary unless the workmen will co-operate. They must help to stop the waste by assisting to get the full benefit from the costly improvements that are so necessary. If modern furnaces are erected and the accompanying labour-saving machinery put down, the workmen must agree to the necessary reductions in the number of men employed and in the wage rates per ton, and this they could very well do because they would still make more money on account of the larger outputs possible with labour-saving machinery, and under less laborious conditions. In the same way the workmen must help when new and more productive machinery is put in engine works, shipyards, mines, or mills, &c. We shall never recover our place in the race for trade until the partners in the venture, that is the master and the workmen, realise that they really are partners, and partners who cannot prosper or indeed exist, without mutual goodwill and co-operation. Any other course is waste, most deplorable waste. I must add my voice to those of many others who have spoken upon the subject, begging the workmen and especially their leaders if they should happen to hear of my words, to believe that the interests of capital and labour, of master and workmen, really are not opposed to each other and it would be utter waste if they were.

Take another case where much remains to be done in waste prevention, namely, the auxiliary machinery in works and steamships. How often we find the greatest care taken to ensure a high degree of economy in main engines and boilers on shore and at sea, accompanied by the most primitive and wasteful auxiliary machinery. Main power plants using, say, 1½ lb. of coal per indicated horse-power per hour or less, accompanied by auxiliaries using anything up to 30 lb., 40 lb. and even 50 lb., when it would be so easy to save 75 per cent. or more of this wasteful expenditure of fuel by such well-known means as the use of electrically-driven machines worked from an economical central power plant. Even without this refinement, very much could be done by a reasonable supervision of auxiliary machinery and the use of feed-water heaters worked by the exhaust steam—or other well-known devices. It would be unnecessary to mention such matters if it were not that there is enormous waste of fuel going on daily on land and at sea from these causes, and more because of inattention and thoughtlessness than from deliberate neglect.

A visit to the shipyards, engine works, and factories of this country shows a great variation in the standard of waste prevention—and in this district there is a high state of efficiency, but probably in all there is some room for careful study and the introduction of modern waste-saving methods and appliances. In many works there are machines which ought to have been condemned and replaced by new ones long ago, and there are obsolete methods and ideas.

Much has been said and written lately about the orders for ships, electric and other machinery, rails, &c., which have been placed abroad—this is a waste of our resources and ought to be considered most seriously by masters and workmen of this country. The statement that subsidies are paid to shipbuilders in other countries appears to be exaggerated, and I think the cause is to be found in many cases in the more up-to-date machinery and the superior works organisation in some of the foreign works, and still more in the hearty co-operation by the workmen, particularly in regularity of working hours and the almost total absence of demarcation rules and disputes—matters to which I propose to refer later.

I will, therefore, pass on to the consideration of a form of waste in our industries which I believe to be far larger and more disastrous, and which must be prevented if we and our district, and indeed our country, are to be saved from ruin. I refer to the waste of capital and of labour, and perhaps more important than all, the waste of goodwill between masters and workmen, because of the apparently never ending misunderstandings and disputes which take place and cause ill-feeling, lockouts, strikes, and all kinds of restrictions to the quick, efficient, and cheap execution of our work. Perhaps the most fruitful cause of these troubles is the misunderstanding by master and workmen of each others' standpoint. The workmen do not realise how the masters must think and scheme and work incessantly if they are to keep their business together and their works occupied. Workmen see masters apparently living at ease, with large house, motor car and other luxuries, and are apt to think that they have an easy time; but they do not see the never-ending work and worry and anxiety of seeking orders, and of finding how to execute the work they get at a cost which will leave a margin of profit, or as it is in these days without a heavy loss, which is of course waste. On the other hand, I fear masters do not always realise the anxiety of the workman lest he should be out of work, or worse still, that his health, which is his capital, may fail or an accident happen, anxieties greatly increased if there be a family of young children or perhaps serious illness at home. All these things are a waste of energy, a waste undoubtedly capable of being greatly reduced by the exercise of good management and goodwill. There can be no doubt that of all sources of waste in our industries, the greatest is that caused by strikes and lock-outs, by demarcation difficulties between trades, and by people of all classes not doing a fair day's work for a fair day's pay.

With regard to the waste caused by strikes and lock-outs, most of them are unnecessary and capable of being avoided by the exercise of patience and goodwill, and by greater effort on the part of both sides to see more of the standpoint of the other. I fear that many strikes and lock-outs are the result of neglect and delay in dealing with difficulties as they arise, and it seems to me that something of the old-fashioned discussion between master and workmen immediately a difficulty appears should be revived. Such discussion should be informal and not binding in any way on the official representatives of either side. By this method a great many disputes would probably never be taken outside the works. If your house is on fire you are bound by the terms of your insurance policy to give notice to the fire brigade, but that does not prevent you from immediately taking what steps you can to put out the fire; in most cases it is overcome without the aid of the brigade and great waste avoided, and if you have not succeeded in your efforts you do not invalidate your insurance. Why not revert to the old-fashioned method of first and immediately dealing in the same way with little outbreaks of misunderstanding and temper in our works? I believe that a large proportion of them could and would be settled satisfactorily. If the question had to go forward for official treatment, these preliminary discussions would have to be regarded as not having taken place. Probably the officials of both masters' and workmen's organisations will look askance at these ideas, but I believe experience would soon satisfy them that no harm would result, and perhaps much good. It is such a terrible waste to be always standing armed and ready for war.

Nearly all of this waste is preventable, and unless masters and workmen can come together in a spirit of reason and common sense, determined to stop such waste, there can be only one result, the inevitable ruin of our trades—and nothing but misery and want for us all. It seems to me that the time has come when masters and workmen really must get together in conference through their confederations, to review and discuss the whole position in connection with the trade difficulties, and try to come to a mutually agreed plan of action. Such meetings would have to be approached and conducted with real goodwill, and would be, in fact, a conference of friends threatened with disaster and all determined to find a way back to prosperity to the common good, and to the prevention of this great waste. In this connection, I think the suggestion which has been made by Sir Robert Hadfield that an endeavour be made to arrange an industrial truce is worthy of the most serious consideration.

Another cause of great waste in our industries is the too strict adherence to the demarcation of work between the different trades. I quite see the point of the workmen that they must retain as much work for their own trade as possible, but surely it would be wiser and certainly more economical in the long run, that is, less wasteful, to exercise more "give and take." The cost of work is greatly increased by the too strict adherence to the rules and especially if a strike or lock-out results, and increased cost is waste.

Then there is the dreadful waste caused by people not doing a fair day's work for a fair day's pay, this in conjunction with the short hours we work being, in my opinion, the greatest cause of the unduly large cost of our production, and the main cause of so much work going abroad. Many of the workmen adopt this course deliberately and as a matter of considered policy; but surely a very little reflection should show them that it is wasteful in the extreme, and, of course, absolutely immoral. And the same argument applies to masters and the members of the staff. A master is just as much in honour bound to work hard and do his best as anyone else, and he is wasting his opportunities if he does not. It astonishes me to see the way in which our modern cafés are full of young men in the middle of the morning of working days; they must be wasting the time and energies which they have sold to their employers. I fear all classes of the industrial community—masters and workmen alike—have yet to complete their recovery from the demoralisation of the war-time and are still wasting much of their energies, and it is a very serious question how to stop all this waste going on throughout industries. It seems to me that we need first of all more, much more, of the spirit of Christianity, that is living and working for each other and for the community—giving and not always taking. The man who does not give a fair day's work for a fair day's pay is no true Christian, nor is he a gentleman. He is wasteful; a waster. A man who stops work without notice and without endeavouring to come to an arrangement with his employer, just because he does not like some minor arrangement of his work, or because some fellow workman is not in the same union, or in no union at all, is wasteful. A master who locks out his workmen without first finding out as far as he can the workmen's point of view and really trying to compose the difficulty, is wasteful.

Much as masters and workmen and their representatives can and should do to prevent waste, they must have the whole-hearted help of the Government and of the local governing bodies who control so largely the conditions under which we live and carry on our business. Surely it is time that the wages in the so-called protected trades were brought into reasonable comparison with the highly-skilled and competitive trades. If the competition in the open markets of the world makes it impossible to pay skilled workmen a certain wage, it is in the highest degree wasteful to pay considerably higher wages to unskilled men, just because a stoppage of their work would be an inconvenience to the public. This really amounts to a kind of blackmail, and I think the time has come for the public to resist such claims, but they must be assisted by the governing representatives who should act in the interests of the people as a whole, and not, as so often happens, favour some particular class of the community.

I have always thought, and still think that one of the best ways to stop waste in our works and prevent the complaints of the workmen that they do not get their due share of the proceeds of their labour, is the adoption of payment by results, and if the arrangements are carefully thought out and managed with fairness, they always give results satisfactory to both master and workmen. A slight knowledge of human nature shows us that everyone works better if he knows that he will have a share of the profits of his work according to his skill and exertion, and experience has shown that the most practicable way of sharing with the workmen is by way of piecework in one or other of its forms. I believe that a large majority of our workmen would welcome the general adoption of payment by result, and I cannot understand why they agree so quietly to the waste of their skill and energy in all being brought to one dead level of remuneration, a level fixed by the capacity of the less efficient men.

I think the extension of the system of payment by results, and the improvement of the relations between masters and workmen, would be greatly helped if the workmen were represented upon the board of directors of the company for whom they work. A workman director would be able to explain more satisfactorily the views of his fellows to his co-directors, and of equal importance, he could make clear to the workmen the ideas of his co-directors, of course exercising proper discretion on both sides. But to be useful, a workman director would have to be a *bonâ fide* workman of known moderation and common sense. No board could manage its business by the methods adopted in many city councils and sometimes even in the House of Commons.

* North-East Coast Institution. Presidential Address, October 17th, 1924. Abridged.

10-Ton Single-Cylinder Road Roller.

We illustrate on page 466 the latest type of single-cylinder steam road roller made by Marshall, Sons and Co., Limited, of Gainsborough, who style it their Class "8" series. This series includes engine weights of from 5 to 20 tons, and both single and compound engines are used. The particular roller which we illustrate weighs nominally, when empty, 10 tons, and it is furnished with a single-cylinder engine, the diameter and stroke of the cylinder being 8in. and 10in. respectively, and the working steam pressure 150 lb. per square inch.

The particular points to which Messrs. Marshalls draw special attention are:—(*a*) That the hind or driving rollers have the bosses and spokes combined in one steel casting, as in the accompanying engraving; and (*b*) that the engine has balanced piston valves. This construction of road wheel has now, we understand, been standardised by Messrs. Marshall for all their rollers. The front rollers are

WHEEL OF MARSHALL ROAD ROLLER

constructed on similar lines, but they are of cast iron, which, in the makers' opinion, is quite serviceable for the purpose. The piston valves are claimed to give great economy in working. We understand that recently one of these new rollers, when worked for eight consecutive hours on water-bound macadam in a very hilly district, only consumed 2 cwt. of coal during that period. The remainder of the roller closely follows Messrs. Marshall's standard construction, with which our readers are familiar. We need not, therefore, describe it further in the present instance. We are asked to say, however, that the scarifier shown fitted to the roller was supplied by Messrs. John Allen and Sons, of Cowley, Oxfordshire.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Philip Chapman and Co., general export merchants, of 5, Copthall-buildings, London, E.C. 2, ask us to announce that they have opened offices in their own name at 19, Rue Nubar Pacha, Alexandria, Egypt. P.O. Box 1048; telephone 1245.

William Boby and Co., Limited, of Brookfield House, 62–64, Brook-street, Hanover-square, W., inform us that by arrangement with Joseph Crosfield and Sons, Limited, they have been appointed sole agents for that firm's "Doucil" base-exchange water softening material.

James Howden and Co., Limited, of 195, Scotland-street, Glasgow, inform us that they have come to an arrangement with Brown-Boveri and Co., Limited, Baden, Switzerland, whereby they become the sole licensees for Great Britain for the manufacture of th Brown-Boveri scavenging blower for two-stroke Diesel engines. The blower, as manufactured by James Howden and Co., Limited, will be known as the Howden-Brown-Boveri scavenging blower, and will be made entirely to the designs and specification of Brown-Boveri and Co., Limited.

CONTRACTS.

An order has just been received by Geo. Kent, Limited, of London and Luton, for seventeen "Venturi" meters for the Tees Valley Water Board.

The Clyde Engineering Company, of Sydney, has contracted to construct thirty-five locomotives for the New South Wales Railways, at a total cost of £400,000.

We learn that the tender of Thos. W. Ward, Limited, Sheffield, for five miles of 6in. steel lap-welded screwed and socketed piping has been accepted by Steel Bros. and Co., Limited, London, for export to the Attock Oil Company, Limited, Rawalpindi, India.

We are informed that the whaler Sir James Clark Ross, which recently sailed from Cardiff for the Ross Sea, was fitted with a Marconi wireless direction finder, and is taking with her five other sets for use on board the small boats associated with her in whaling. The Sir James Clark Ross is fitted with a Marconi 3-kilowatt telegraph-telephone transmitter, which will enable her to give instructions to the small boats when they are out on expeditions for whales, and, as not infrequently happens, they are overtaken by fog or darkness and have difficulty in finding their way back to the parent ship.

Vickers Limited, Barrow-in-Furness, have received a repeat order from Messrs. Barber, Walker for a complete and exactly duplicate set of winding engine mechanical parts for the Harworth Main Colliery. The main contractor is the Metropolitan-Vickers Electrical Company, Limited, and the winding engine is said to be the largest electrically driven winder in this country. The same firm has received an order from the Foundation Company, Limited, acting on behalf of Messrs. Lafarge, for the first clinker grinding plant, comprising tube mills, to be installed in this country in connection with the manufacture of ciment fondu.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Situation.

The trade situation in the Midlands and Staffordshire shows no improvement, business being on the quiet side, and the tone of the market depressed. It is open to question whether iron and steel values can be stabilised on the basis of present prices, and until consumers feel assured on this point forward buying is not to be expected. At to-day's meeting values were irregular and business was for small tonnages only. The political situation is having the usual disturbing effect upon business, but Midland manufacturers are hoping that the result may be to give us a long period of stable rule under a Government strong enough to make the country feel secure against subversive elements which have done so much to unsettle confidence and retard industrial enterprise.

Staffordshire Iron Trade.

The Staffordshire finished iron trade as a whole continues depressed, with little prospect of an increase in activity in the near future. Makers of best iron, certainly, continue fairly busy and maintain their price of £15. This high-class iron is used largely for exacting engineering requirements, rolling stock building, &c. Makers of Crown quality iron continue very poorly employed, and it is easy to get substantial concessions below the £13 figure. There is exceedingly keen competition from the Continent in the lower-grade bars. Belgian No. 3 iron has been further reduced to £7 10s. delivered, but the local nut and bolt works are not busy and have still large quantities of foreign bars delivered during the summer. The amount of native nut and bolt iron being sold is extremely small and demand for fencing iron, too, is very meagre. Makers continue to quote £12 for this class of iron, saying they could not afford to reduce it even if there was a reasonably large inquiry. Many of the Staffordshire mills continue to re-roll continental semi-finished material, and they are competing keenly with steel masters for the available orders.

Sheet Values Declining.

The downward tendency lately noted in galvanised sheet prices continues. For 24-gauge corrugated £17 17s. 6d. has been accepted this week, and it is doubtful if that figure represents the bottom of the market. Trade is again quiet, particularly on export account.

Pig Iron.

There is very little, if any, improvement in the demand for pig iron, forge as well as foundry. Consumers are not certain that values have reached bottom, and they continue to satisfy immediate needs, permitting the future to care for itself. On 'Change in Birmingham to-day—Thursday—values were a little uncertain, but quotations did not show such great variation as a week ago, an indication that the market is recovering from the unsettling effects of the readjustments brought about by the lowering of coke prices. Foundry brands came in for more inquiry than forge, and it would appear that Derbyshire quotations are now being brought into more normal relation with those of Northamptonshire furnaces. Consumers claim to have been offered supplies of Derbyshire No. 3 at £4 at furnaces, and Northamptonshire foundry at £3 15s. North Staffordshire foundry continues to be quoted £4 5s. There was hardly sufficient inquiry for forge sorts to give an accurate idea as to values, but the quotations generally mentioned were Derbyshire, £3 15s.; Northamptonshire, £3 9s. to £3 10s.; and North Staffordshire, £3 16s. Many Midland blast-furnaces continue inactive, and there appears little probability of any of them being put into operation this year. Continental pig iron continues to come into this country in increasing quantities. The amount of basic pig imported last month was more than double that imported in August—11,100 tons, against 5408 tons—and this notwithstanding the fact that there are heavy stocks in the hands of producers at home for which there is no market. Forge and foundry pig from Belgium was also more, the total amount landed being 9588 tons, against 6732 tons in August. Yet while our imports of pig iron are increasing our exports are diminishing. Last month we exported only 26,094 tons, against 33,990 tons in August and 35,541 tons in July. For the nine months exports aggregated 361,661 tons, the figure for the corresponding period of last year being 576,736 tons.

Raw Iron Output Diminishing.

It was to be expected that the returns of raw iron production would show no expansion on last month, but one hardly expected to find production continuing to shrink, even though stocks generally are stated not to be heavy. The output of the blast-furnaces for September was 569,200 tons, the lowest for the past twelve months, and compares with 588,900 tons in August and with a pre-war monthly average of 855,000 tons. The number of furnaces in blast throughout the kingdom at the end of the month was 170, a decrease of three since the beginning of the month, and the lowest number in blast since December, 1922. The production includes 187,100 tons of hematite, 183,500 tons of basic, 145,500 tons of foundry, and 29,300 tons of forge pig iron. The output of steel ingots and castings in September showed a little improvement upon the previous month, amounting to 645,000 tons, compared with 527,500 tons in August and 689,300 tons in July.

Steel Values.

In the steel market the acute competition which has prevailed in structural material has led to definite price changes. For some weeks past there has been a wide difference between the prices paid and those which stood as the standard quotations of the Associated Steel Manufacturers. Now they have been brought into closer relation to realities. Indeed there has been a general marking down of steel prices. Angles and joists are officially down to £9 5s. per ton, ship, bridge and tank plates to £9 15s., and boiler plates to £13 10s. In each instance, in relation to plates, the reduction on the official quotations is about 10s. per ton. No re-animation, however, is to be noted as a result of the lowering of prices. The fact is, the position has undergone little real change, as the prices now acknowledged have applied to most of the orders taken for some time past. Staffordshire hoop manufacturers have reduced their basis from £12 to £11 10s. Continental competition continues very forceful, the Belgians offering joists at £6 17s. 6d. delivered in the district. Business in constructional steel continues to show improvement. The railways are ordering rather more freely and are inviting tenders for various dock, engine shed and other extensions, which will call for good tonnages of steel. Substantial quantities of girders are being used in building operations, which are becoming more extensive. Native soft steel billets are in poor inquiry. Black Country mills are carrying on very largely with continental semis. The home makers of ordinary soft billets have no chance with the foreigner. The latter is prepared to send in supplies at a little over £6, whereas the English producer cannot make ends meet at £7 10s. This week some firms are asking £7 12s. to £7 15s., but there is little business to be had even at the £7 10s. figure. The steel trade is still very much in need of orders, especially for such heavy products as rails and joists. It is a great misfortune to the trade that, with building active, foreign joists are being brought in in increasing quantities, 9220 tons being imported in September, against 5609 for the corresponding month of last year. Of foreign rails the imports were 15,774 tons for the nine months, as against 7289 for the same month last year. This is a more serious matter than the importation of semi-finished material like billets, the finishing of which employs a considerable amount of labour.

Exports and Imports.

Midland industrialists regret to find that while our exports of iron and steel sunk in September to a lower level than they have touched in any previous month this year, we imported more in point of tonnage than in any of the other months save May. Imports have trebled since 1922 so far as quantity goes. The increase in value is not so great, but the 1924 aggregate is more than double that of 1922. Meanwhile the tonnage of exports, after creeping up from 2,340,832 in the first nine months of 1922 to 3,181,175 in the corresponding period of last year, has receded this year to 2,929,162. The value, however, gives an increased total. The position compares very unfavourably with pre-war days. In the first nine months of 1913 we imported 1,617,902 tons of iron and steel, 1,135,757 tons less than in the nine months just ended, while we exported 3,751,463 tons, or 822,301 tons more.

Workless.

The latest returns of unemployment show there has been a further reduction in the number of persons out of work in the Midlands. For the week ended October 13th the total number of unemployed was 146,741, as compared with 149,027 the previous week, a decrease of 2286. The latest total is distributed as follows:—Men, 103,643; boys, 2661; women, 36,846; girls, 3591. There has been a small increase in the number of women on the Employment Exchange registers, but in the case of men there has been a falling off of 1958. In the Birmingham area the returns show a decrease of 1518, the figures having fallen from 38,060 to 36,542. At Coventry also there has been a decline on the week, the present figure of 3516 being 223 fewer than the previous week. Other Midland towns where decreases were recorded are Bilston, Derby, Longton, Oldbury, Smethwick, Stourbridge, Brierley Hill, Walsall, West Bromwich, Wolverhampton.

Locomotive Contract.

It is understood that a contract for fifty locomotive boilers has been placed by the Great Western Railway with Kerr, Stuart and Co., Limited, of Stoke-on-Trent. This firm is now completing thirty boilers for the London, Midland and Scottish Railway.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

The general position in the iron and steel section of the trade is certainly weaker than it was, although this weakness has not extended to the non-ferrous metal market. Why iron and steel should be weaker, in the prospect of a change of Government, it would be difficult to say, for it is generally believed here that if the Conservatives came into real power measures would be taken under the "Safeguarding" Act to check imports of cheap iron and steel; and, on the other hand, if the Labour and Liberal combination should again be in power conditions would not be any worse than they are now. Hence, so far as political influences are concerned, the outlook for iron and steel prices is no worse than it was. Probably the real reason for the depression at the moment is that a great many people are now inclined to postpone all thought of serious business until after the election and probably until after the turn of the year.

Metals.

The demand in the Lancashire district for the non-ferrous metals is rather restricted, but so far as copper is concerned this restriction is not caused by any fear of lower prices. It is no doubt partly in consequence of the small amount of engineering work now available, and partly because consumers of copper do not see any reason for believing that higher prices are near at hand; and hence they may just as well buy little lots from hand to mouth

and keep the money at the bank. If there were any widespread belief that copper was approaching a rise one might expect a good deal of buying here for the purpose of replenishing stocks in consumers' hands. The quotation of merchants for refined ingot copper delivered here has kept round about £67 10s. per ton. There seems to be some idea that buying of copper will be stimulated by the success of the German loan, and there may be truth in this supposition. There is no doubt that Germany is slowly recovering her consumptive power in the copper market, and this is a "bull" point which has to be kept in mind; but the world consumption of copper is yet a long way behind the world capacity for production. Any rise in selling prices would no doubt quickly stimulate production. The prices for manufactured copper and brass in Great Britain remain comparatively high for the home trade. In this connection it may be observed that the German exports of rods and sheets this year are just twice as heavy as they were last year. Is this because British prices for manufactured material are out of relation with the prices for raw material? The market for tin has been rather steadier of late, and shows a power of recovery from any "bear" attack, which suggests that the level is now considered fairly safe. Of course, no one can know what may happen, and a sharp recovery in the American tin-plate trade might alter the complexion of affairs very suddenly. Lead has remained a strong market, and it must be admitted that prices begin to look rather extravagant. Some sort of set-back would not be unnatural, although the underlying conditions seem good. Spelter remains very quiet, but the condition of the market is fairly steady.

Pig Iron.

Buyers of foundry iron in this district are still holding back and postponing their orders until the last moment. It was thought a month ago that if the delivered price of No. 3 iron in Manchester could be brought down to 90s. consumers would begin to buy more freely for future needs; but so far as can be seen, now that the top price in Manchester is 90s., they are just as reluctant to buy as when it stood at 95s. Of course, there must be an end to this persistent sagging in the price of foundry iron, and some people think that it may not be worth while to wait until the last shilling has been squeezed out of the makers; but others point out that just before the French occupation of the Ruhr foundry iron in Manchester fell to 85s. per ton, and they argue that the restoration of the Ruhr to German control may and should bring down our prices by another 5s. On the other hand, it may be contended that any further depreciation of Midland iron must be preceded by a further fall in furnace coke, and the ovens which have now to sell on a basis of 16s. 6d. per ton cannot be expected to work at less. In Manchester the pig iron market is certainly very weak, but this may be partly because all the markets are disturbed by the utter uncertainty of the political situation. With a really stable Government secured for five years there would be a very different feeling in trade circles; but many people here think that there is not the slightest chance of obtaining a stable Government. There has been no further reduction in the price of Scotch iron here, but the demand is very much restricted and sales are reported at considerably less than the ostensible figure, viz., 106s. 6d. delivered in Manchester. East Coast hematite is very much cheaper than Scotch and could be bought in Manchester at 100s.

Steel.

There has been a further development of weakness in the markets for manufactured steel all over the country. Here there are reports of common steel plates at £9 15s. per ton delivered, and joists and angles at £9. Steel bars are easier and some orders for round bars appear to have been taken at £10. Flat bar steel can be bought at £9 15s. The Lancashire Bar Iron Association has announced a reduction in Crown bar iron of 10s. per ton, making the price £12 10s.; but it is very difficult to believe that this drop will have any effect whatever upon sales of Lancashire iron. Really good qualities of foreign bar iron are offered quite freely here at £10 per ton delivered, and, of course, the commonest qualities, suitable for fencing work, are much cheaper.

Scrap.

Dealers in scrap on the Manchester Exchange are exceedingly low-spirited at present. There is practically no demand in any department, although now that the Sheffield steel works are getting into operation again it is possible that there may be some revival there in the demand for heavy melting steel scrap. Dealers, however, do not anticipate that they will be able to get more than 70s., which would barely leave 60s. on trucks here. Iron manufacturers will now probably expect to get their heavy wrought scrap on cheaper terms, to make up for the 10s. per ton taken off the price of bar iron. At present some of them are offering only 80s. per ton for scrap delivered into their works. The weakness of pig iron is, of course, reflected in the cast scrap market, but the prices here are still quoted from 80s. to 85s. per ton according to quality. There is a small demand for fine broken textile machinery scrap at 85s. per ton delivered.

BARROW-IN-FURNESS.

Business Quiet.

Business in hematite pig iron is very quiet indeed, and there is little doubt that many works are compelled to put some of their make into stock. There are only eleven furnaces in blast in the whole of the district, but there is not sufficient demand to absorb even their output at present. If there were more activity in the steel departments it would be a different matter, for then they would take a pretty large amount. Trade is mostly confined to the Midlands and Scotland, but there have been shipments to Treport and Havre, also to North Wales, and a part cargo of Barrow-made pig iron has been shipped to Philadelphia. As to the extent of the American trade, it is impossible to say at present. There was a shipment of galvanised iron to Australia last week, which was taken by the new Orient liner Orama, which had just been completed by Vickers. There was over a thousand tons of it and it came from South Wales. It was useful in the case of the new steamer, as it helped to ballast her on her trials.

Iron Ore.

There is not much being done in the iron ore trade and there are no signs of an improvement. Until the iron trade improves locally there will be no change. There are a few mines in Cumberland which are busier than elsewhere, but there is much room for improvement, for little is going out of the district. The business being done in the foreign ores is on a limited scale.

Steel.

There is nothing fresh to report regarding the steel trade, which is very quiet indeed, with little hopes of a change for the better at the moment. Really the only departments which are regularly engaged are the hoop and small section mills at Barrow. The rail mills at Workington have been working, but they have not sufficient orders to keep them busy. Steel plates and rivets have been imported from Rotterdam recently.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Trade.

There is little or no improvement to report in the condition of the heavy steel trades of Sheffield and district. The open-hearth steel and pig iron branches are still very depressed. The basic side is the worst off, and the demand for billets is only such as to satisfy actual day-to-day requirements, and those on only a limited scale. There is a rather better sale for acid steel, but the position here, too, is very unsatisfactory. There is, however, a belief that a revival of trade will not be long delayed, and this is supported by the fact that inquiries for pig iron show some progress. A branch of the heavy trade which has lately been re-started is that devoted to the making of armour plate. The local plants, which had been idle for a considerable time, are now at work on the plates for the protection of the two battleships at present in course of construction. The orders for the armour for the cruisers will be placed in due course, but as this armour is thin and light the work will not consume much labour, time or material. Vickers Limited have laid the keel of one cruiser at their Barrow yard, and are to start immediately on the work of construction, which will occupy three years. The amount of railway work coming forward, although considerable, is not sufficient to keep the plants fully employed. The volume of orders from the home companies is not as large as could be desired, while the export business has been poor for several years. Only a moderate amount of work is on hand in the wagon building department.

An Optimistic Note.

The belief in a revival, which I mentioned just now, is shared by the chairman of the United Steel Companies, Limited, whose speech at the annual meeting of the combine on Monday contained some interesting passages bearing on this matter. He remarked with satisfaction that, taking the past year as a whole, there had been an increasing volume of business done in the higher quality steels for which the Sheffield works were famous, and this led to the hope that this class of trade would again absorb the major portion of the output of these works. As to the future, he said that he and his fellow directors believed that conditions were on the upward trend and that every day was helping towards general stability. "The unsatisfied requirement in regard to steel all over the world," he said, "is enormous. That this unsatisfied demand will become before long an insistent effective demand backed by adequate purchasing power we firmly believe, and although one may not prophesy with safety we feel that the improvement is not so far off as we may be apt to think during a time of depression."

The Engineering Side.

For steel castings, sheets, and cold rolled steel there is a fairly good demand, but in the wire trade work is only moderate. The rolling mills are turning out less than an average output, and the forges which are active are only in the minority. There is considerable activity in electrical engineering, and the quantity of work coming forward from the shipyards shows some increase. The export demand for textile machinery continues strong, while in the home market the inquiry for machine tools is better, owing to the gradual exhaustion of surplus war machines. Tool steel and small tools are being bought on a fairly substantial scale by the motor industry, and one or two of the more important engineering branches. The tool steel branch generally, however, is not in a satisfactory state. It has not recovered from the sharp fall in business which followed the August holidays, and the firms with any appreciable weight of orders on their books are few.

The Cutlery Trade.

A marked improvement has taken place in the cutlery trade during the last two or three weeks, due to heavy buying for the Christmas demand. The call for stainless table knives grows from more to more, but prices are severely cut, and competition is so keen that many of those engaged in the business declare that it is unprofitable. Dealers in hafting material report that sales continue to increase. There is also a greatly increased demand for the better class of pen and pocket knives, and some houses which specialise in them are working under great pressure. The old-fashioned razor trade has lost much of its former prosperity, but it still has several good markets abroad, mainly Australia and India, while at home it does a considerable business with the Army, Navy and the hairdressing trade. In September, 1922, the number of razors exported fell to the very low level of 1786 dozens, but a year later the figure was 6710 dozens, while in the corresponding month of this year it had risen to 12,315 dozens.

Electro-plate Busy.

The Christmas demand is also responsible for very active conditions in the electro-plate industry, and the conditions prevailing are more like those of October in the good old days than they have been for several years. The rush of orders for forks and spoons and cased goods has probably never been equalled. The quantities of goods going out from the works far exceed those of the later pre-war years. Some factories have enough work on hand to keep them fully employed until near the year-end. The demand is chiefly for articles of cheap or moderate price, and touches good-class hollow ware and sterling silver ware to only a limited extent, but at the same time the high-class firms are doing more business than for several years past.

A Pipe Contract.

The tender of Thos. W. Ward, Limited, Sheffield, for five miles of 6in. steel lap-welded screwed and socketed steel piping has been accepted by Steel Bros. and Co., Limited, London, for export to the Attock Oil Company, Limited, Rawalpindi, India.

Municipal Schemes.

The Estates Committee of Sheffield City Council is to present a report on the present rate of progress in house building, and its proposals for its acceleration. At a meeting of the City Council last week it was stated that, as a result of the Committee's visit to Birmingham, it was seeking tenders for the building of about 1000 houses of concrete. Mansfield Town Council has decided to make application to the Electricity Commissioners for permission to extend the present plant by the addition of a 2000-kilowatt turbo-alternator, at an estimated cost of £35,000. At Chesterfield a Ministry of Health inquiry has been held with reference to the application of the Corporation for sanction to borrow £5000 for the erection of public baths for the Hasland and Birdholme districts. The total cost will approach £8000, towards which the local Miners' Welfare Committee will contribute £3000.

NORTH OF ENGLAND.

(From our own Correspondent.)

A More Hopeful Feeling.

Although there has been no material improvement in the general trade position in the North of England, there is a more hopeful feeling that the end of the long period of depression is in sight. It is true that business has not shown any sign of expansion as yet, but encouragement is derived from the prospect of a change of Government, the general view among the trading community being that such an event is likely to assist trade revival, particularly if the result of the election assures a fairly lengthy term of office to the party returned to power.

Cleveland Iron Trade.

Whilst any substantial increase in the volume of business is not expected until after the verdict of the polls has been cast, there is a more confident note in the Cleveland pig iron trade. More inquiry is reported from various directions, and the improved tone is reflected in the stiffening of the attitude of makers generally. The determination of the ironmasters to stabilise prices has met with some measure of success. Prices which a week ago could be shaded are now quite firm quotations. Purchasers are apparently becoming convinced that nothing further is to be gained by waiting, and though still inclined to operate with caution, they are prepared to discuss business at current rates. Both for foundry iron and for hematite, the demand is rather better, but practically all the business is for early delivery, and the forward position will probably be neglected until after the election. No. 1 Cleveland foundry iron is scarce at 85s. per ton, and makers refuse to cut below 80s. for No. 3 G.M.B. Cleveland iron. No. 4 foundry is offered at 79s., and No. 4 forge at 78s. per ton.

Hematite Pig Iron.

The consumption of East Coast hematite scarcely balances the output, even though it has been considerably curtailed during the past few weeks, and some of the works are stated to be accumulating large stocks. Some of the makers, however, absolutely refuse to cut below 87s. 6d. per ton for mixed numbers, and 88s. for No. 1, although in other directions purchases are possible at 6d. per ton below those figures.

Ironmaking Materials.

The foreign ore trade is lifeless. In view of the uncertain position, consumers are not inclined to increase their already large stocks, and business is rarely heard of. Sellers of best Rubio ore put the price at 21s. 6d. per ton, c.i.f. Tees, but an offer of business at 21s. would probably not be refused. Good furnace coke remains steady at 25s. per ton delivered at the works.

Manufactured Iron and Steel.

The manufactured iron and steel trade shows little signs of improvement, and many of the works are finding it more and more difficult to keep their plant in operation. The recent price cuts have not brought in much business, except a little for constructional steel. Corrugated galvanised sheets are a shade easier at £18 for 24 gauge kinds, and a drop of 10s. in common iron bars is reported, the price now being £12 per ton.

New Gas Holder.

The Middlesbrough Town Council this week decided to accept the tender of the Furness Shipbuilding

Company for the erection of a steel tank and spiral gas holder, at a cost of £37,000.

The Coal Trade.

The position in the Northern coal trade is still causing considerable anxiety. Not for many years has the depression been so acute, and at the moment there appears to be little on the horizon to warrant the least optimism. Although the fall in coal prices during the past few months has been heavy, Germany is still undercutting and securing a large proportion of foreign business. As indicating the effect of this competition, the Landscrona Gasworks, which recently took supplies of Durham gas coals, and invited offers for a further consignment, has fixed up with German merchants for the next supply. It is declared that the worst in the direction of foreign competition has yet to be experienced, but Northern collieries are not inclined to do business for the beginning of next year at present prices. The general tone of the market is very quiet, but there has been some little movement in best Northumberland steam coals for prompt delivery. In other respects there are no new features in the market. The coke trade is dull, and the trend of the market points to a slack time, with ample stocks offering at concession prices. Gas coke is weakly held at 35s. to 36s., and the tendency is all in favour of buyers. Patent oven coke is weak at 22s. 6d. to 25s., and beehive at 30s.

SCOTLAND.

(From our own Correspondent.)

Conditions Unaltered.

Conditions in industrial circles generally are unchanged and prospects of improvement are still obscure. In practically all industries business negotiations are confined within small limits, buyers showing no inclination to anticipate future requirements even on a restricted basis. Home prices of certain materials have dropped a little, but it is doubtful if the reduction will bring any increase in turnover. Unless the home product is firmly specified consumers can hardly afford to ignore the cheaper foreign article. Even the latter is not selling to any great extent owing to the scarcity of new business in almost all industries, though at the same time the quantities bought from abroad would be welcomed by the local producer. Just at present, however, interest on 'Change and elsewhere is almost wholly absorbed in political affairs.

A Mining Scholarship.

An offer of a sum of £250 for one year for a post-graduate travelling scholarship, made on behalf of Messrs. Mavor and Coulson, electrical engineers, Glasgow, has been accepted by the Council of the Institution of Mining Engineers. An additional sum of £50 will be given if America is included in the itinerary of the selected candidate. The firm intends to offer a similar sum annually for the same purpose. The scholarship is open to British subjects between the ages of twenty-one and twenty-six years who are student members of the Institution, and who have graduated in mining at a university or college, or have taken the Associateship of the Royal School of Mines. Arrangements are to be made for the candidate spending one year visiting collieries chosen by the Council of the Institution and these collieries may be in Britain, the Continent of Europe, Canada, or the United States.

Weakness in Pig Iron.

No change is apparent or reported in the pig iron market. Inquiries for foundry qualities are fairly numerous, but definite orders are practically as scarce as ever. The export department is very idle. Prices all round are weak and tending to become easier.

Bar Iron.

Few of the bar-iron works can see more than a very few days ahead. The home demand is extremely poor and the prospects of export transactions are small indeed. The re-rolled steel branch of this industry is similarly placed.

Steel.

Steel makers have reduced their prices by 10s. per ton, but it is considered doubtful if the reduction will result in extra business at present. Black sheets have also been reduced, but galvanised varieties remain on a very firm basis. Specifications for plates and sectional materials are extremely difficult to obtain, and a considerable portion of the plants is inactive. Foreign materials are offered considerably below the home product. In the case of angles, for instance, the difference is 30s. per ton. Galvanised sheets are well placed. Some makers are fully booked until the end of the year. An increase in the orders for black sheets would, however, be welcomed.

Dullness in the Coal Market.

The weakness which has developed in the coal market seems to increase week by week, and it seems more and more obvious that the competition from continental and German sources, especially the latter, is being most severely felt. Home prices have suffered reductions, but the foreign prices are still lower, and local collieries find a great shrinkage in their normal export trade. Buyers abroad will not purchase unless for immediate consumption, thereby assuring themselves of the lowest price current at the moment. Apart from screened navigations in Lanarkshire and Fifeshire and third-class steams in the latter district practically all descriptions of round show a weakening tendency. Treble and double washed nuts sell well in Fifeshire and the Lothians, but are not moving off so freely in Lanarkshire. Single nuts, pearls and drosses are most inactive. Aggregate shipments for the past week amounted to 231,126 tons, against 284,340 tons in the preceding week, and 324,356 tons in the same week last year. In the home market the demand for industrial fuel is most unsatisfactory, but household and municipal requirements are comparatively heavy.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

No conspicuous alteration has taken place in the general state of the steam coal trade since I wrote a week ago, but it is some satisfaction that the conditions are no worse. In some directions, the position of collieries is a shade improved, inasmuch as tonnage arrived more freely during last week-end, and consequently some undertakings are more comfortably placed, but whether these conditions will continue remains to be seen, as the taking up of tonnage is considerably below the average. Some exporters are undoubtedly finding difficulty in securing the prompt tonnage they require; while, on the other hand, the inquiry from abroad does not materially improve, so that the prices obtainable are still comparatively low, leaving little or no profit in business. The most interesting development is that concerning business which has been done in coals for shipment over 1925. Up to recently buyers have held aloof from operating, but the ball has now been started, and so far as can be gathered the contracts concluded represent a fall of approximately 1s. per ton as compared with the current year's contracts. It is reported that the Central Argentine Railways and other South American railways have bought about 400,000 tons of superior second Admiralty large coals at a price of about 26s. for delivery over the next twelve months, while the French Midi Railways have purchased about 250,000 tons of steam coal and patent fuel for delivery over the same period. From all accounts, the railways have bought 140,000 tons of through coal and 30,000 tons of Cardiff or Newport locomotive large coal, as well as 80,000 tons of patent fuel. The firms which have taken the business are Pyman, Watson and Co., Franklin Thomas and Co., Limited, and H. F. Thomas (Cardiff), Limited, the first-named firm having obtained the major portion of the contract.

Fitters' Strike Ended.

The strike of fitters employed by the South Wales dry dock and ship-repairing undertakings came to an end this week. Owing to a dispute regarding wages, the members of the Amalgamated Engineering Union suspended work on August 18th last, and their action naturally curtailed considerably the operations of the employers, as, of course, there has been a fairly substantial amount of work which they could not undertake in view of the absence of the fitters. At the same time, the employers have been able to get through more work than was at one time thought possible. Negotiations were carried on last week between the representatives of the workmen and the employers, and reached a stage by Saturday which enabled the leaders to place the proposals before the men over the week-end. As the result of the ballot which was taken, the leaders again met the employers on Monday, when it was announced that a mutual agreement had been reached on all points in dispute, and an agreement was signed enabling a resumption of work on the part of the fitters, &c., on Wednesday. No disclosure was made by either side as to what the exact terms of the agreement were, except that the employers promised that there should be no victimisation, that there should be an equitable distribution of work, and it was stated that there should be a stable rate of 70s., plus 50 per cent. per week for oxy-acetylene workers. So far as the fitters are concerned, it is very questionable whether they have gone back to work on terms any better than those which were originally offered by the employers, as this would only provoke other classes of workmen to demand similar treatment.

Miners' Wages Agreement.

The new South Wales Coal Board agreement was signed at a meeting of the Conciliation Board on Tuesday at Cardiff. The men's leaders intimated that they accepted the employers' offer made under the anomalies clause to increase the standard rates of craftsmen from 8s. 0½d. to 8s. 6½d. per shift, but they strongly opposed the date upon which this was to operate, viz., the 20th inst., and contended that it should apply retrospectively. It was made known that the owners had entered into an agreement with the Colliery Engineering Boilermen and Craftsmen's Association that there should be no retrospective payment. The miners' leaders expressed their condemnation of the owners' action in dealing with a sectional society and declined to accept the position. They asked that the matter should be referred to Lord Buxton, the independent chairman of the Board, for settlement, but the owners replied that they must have time to consider whether it was a matter coming within the jurisdiction of the independent chairman.

Steel and Tin-plate Wages.

It is announced that the ascertained selling price of tin-plate bars for the three months ended September 30th was £8 8s. This forms the basis of the sliding scales governing wages in the South Wales Siemens steel and tin-plate trades, and means a reduction of 2½ per cent. on existing basis in the steel and tin-plate trades, bringing the sliding scale percentage of the former from 36¼ to 33¾ per cent., and the latter from 11½ to 8¾ per cent. This will apply to wages from November 2nd to January 31st.

Scientist Honoured.

South Wales coalowners and members of the South Wales Institute of Engineers met on Tuesday at Cardiff to do honour to Sir William Galloway. To commemorate the knighthood conferred upon him, the chairman of the South Wales Coalowners' Association (Mr. Robert Gibb, jun.) presented him with an inscribed gold watch on behalf of that body. Mr. W. A. Chamen, the President of the South Wales Institute of Engineers, presented Sir William with an album containing an illuminated address, signed by all the office-bearers of the Institute, this address setting forth the valuable services which he had rendered to the mining industry by his research work, which resulted in minimising the dangers of explosions.

Current Business.

Comparatively little new business has been fixed up on current account during the past week, and the market continues to be weak for prompt shipment, though this weakness is not so pronounced as was the case recently. Quite a number of collieries have considerable quantities of standing coal, which limits their supply of available wagons, and makes it difficult for them to maintain regular working at their pits. Best Admiralty large coals remain about 27s. to 27s. 6d., while second qualities range from about 25s. to 27s. Monmouthshire descriptions are irregular, while dry coals maintain a comparatively good tone and are quoted up to 28s. for the best. In the case of smalls, best bunker sorts have slightly improved, as the supply is somewhat curtailed by the intermittent working of pits, and they are quoted up to 16s. Patent fuel and coke show no change, while in the anthracite section the market is scarcely as firm as it was a week ago, except in the case of large coals, nuts, cobbles, and beans.

Latest News from the Provinces.

THE MIDLANDS AND STAFFORDSHIRE.

Midland Electricity Scheme.

The Electricity Commissioners sat at Wolverhampton this week to inquire into the amended proposals submitted with regard to the scheme for the establishment of the North-West Midlands electricity district (southern section), which the Commissioners had already provisionally approved. The proposals provided for the division of the southern from the northern portion of the original area, the exclusion of a small area in Shropshire and for the erection of a large power station at Ironbridge instead of at Rugeley. The opposition was largely of a formal character, and at the close of the inquiry it was intimated that the necessary draft order would be duly issued.

LAUNCHES AND TRIAL TRIPS.

Papuan Chief, single-screw steamer; built by Harland and Wolff, Limited, for service in New Guinea; dimensions, 120ft. by 23ft. by 10ft.; to carry 229 gross tonnage. Engines, triple-expansion, pressure 180 lb.; constructed by McKie and Baxter; trial trip, September 24th.

Manuela, twin-screw tanker; built by the Rotterdamsche Droogdok Maatschappij; dimensions, 305ft. by 50ft. beam; to carry 2698 gross tonnage. Engines, two triple-expansion; constructed by the builders; trial trip, September 27th.

Antenor, twin-screw steamer; built by Palmer's Shipbuilding and Iron Company, to the order of Alfred Holt and Co., Limited; dimensions, 517ft. 6in. by 62ft. 3in. by 39ft. Engines, two sets of Parsons steam turbines, pressure 220 lb.; constructed by the builders; launch, September 30th.

Luna, lightship; built by J. I. Thornycroft and Co., Limited, to the order of the Commissioners of the Port of Calcutta; dimensions, 105ft. by 24ft. by 15ft. Engines, paraffin motor, which will be removed on arrival at Calcutta; constructed by the builders; launch, September 30th.

Rio Dorado, steel screw steamer; built by the Blyth Shipbuilding and Dry Docks Company, Limited, to the order of the Thompson Shipping Company, Limited; dimensions, 404ft. by 53ft. 4in. by 37ft.; to carry 8500 tons. Engines, triple-expansion, 26in., 43in., 72in. by 48in. stroke; constructed by the North-Eastern Marine Engineering Company; trial trip, September 30th.

Post Office Tube Railway.—We mentioned in an article on the Post Office Tube Railway in our issue of October 10th, that Spencer (Melksham), Limited, had received an order for conveying plant. We now learn that orders have been placed with Geo. Robson and Co., Limited, of Sheffield, also for conveying plant, and with Marryat and Scott, of London, and A. and P. Steven, of Glasgow, for lifts.

Cast Iron Piston Rings.—An interim specification for cast iron piston ring pots for motor car engines has just been issued by the British Engineering Standards Association. Limits for the chemical composition of both sand and chill castings are included, together with the requirements for tensile and elasticity tests for rings cut from the pots selected from the day's cast. The specification includes a list of the automobile standards now available. Copies of the specification (No. 5004) may be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, London, S.W. 1, price 1s. 2d. post free.

Scholarships in Naval Architecture and Marine Engineering.—The following scholarships in naval architecture and marine engineering have been awarded by the Council of the Institution of Naval Architects:—Naval Architecture: The Beardmore Scholarship (£150 per annum for three years), to Mr. W. M. McKitterick, of Harland and Wolff, Belfast; and the Fairfield Scholarship (£150 per annum for three years), to Mr. R. G. S. Kennedy, of Scott's Shipbuilding and Engineering Company, Greenock. Marine Engineering: The Weir Scholarship (£150 per annum for three years), to Mr. G. G. McDonald, of G. and J. Weir, Glasgow.

The Institution of Petroleum Technologists.—At the opening meeting for the 1924–25 session of the Institution the following awards of medals and scholarships were announced:—The Boverton Redwood Medal—retrospective—for the sessions 1919–20 and 1920–21 has been awarded to M. Paul de Chambrier, of Pechelbronn, for his paper on "The Working of Petroleum by Means of 'Shafts' and 'Galleries,'" which was read before the Institution on February 15th, 1921. As there was no paper of outstanding merit for the sessions 1921–22 and 1922–23, no award has been made for those sessions. The Students' Medal and Prize has been awarded to Lieutenant J. H. Blakiston, R.N.R. (late student of the oil technology course at Birmingham University), for his paper entitled "The Oilfields of Roumania." An Institution's Scholarship has been awarded to Mr. Ernest Clark, of the Royal School of Mines. An award to a student of Birmingham University will be announced shortly.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	17/6 to 24/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 15 0	—
No. 1 Foundry	4 15 0	—
No. 3 Foundry	4 10 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 7 0	4 7 0
No. 1	4 7 6	4 7 6
Cleveland—		
No. 1	4 5 0	4 5 0
Silicious Iron	4 5 0	4 5 0
No. 3 G.M.B.	4 0 0	4 0 0
No. 4 Foundry	3 19 0	3 19 0
No. 4 Forge	3 18 0	3 18 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 16 0	—
„ „ Foundry	4 3 0	—
(3) Northampton—		
Foundry No. 3	3 15 0	—
„ Forge	3 9 0 to 3 10 0	
(3) Derbyshire—		
No. 3 Foundry	4 0 0 to 4 1 6	
Forge	3 15 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 10 0 to 4 12 0	
No. 4 Forge	4 12 6 to 4 15 0	
Basic	4 5 0 to 4 10 0	
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 5 0 (a) / 5 10 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best „	—	—
N.E Coast—		
Common Bars	12 0 0	—
Lancs.—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	13 0 0	—
Best „	13 10 0	—
Hoops	15 0 0	—
Midlands—		
Crown Bars	12 15 0 to 13 0 0	
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	—
Gas Tube Strip	13 0 0 to 13 5 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ¾in. and up	9 15 0	—
Sections	9 10 0	—
Steel Sheets, 3/16in. to ¼in.	12 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 15 0	—
Angles	9 10 0	—
Boiler Plates	13 0 0	—
Joists	9 10 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
Manchester—		
Bars (Round)	10 0 0 to 10 10 0	
„ (others)	9 15 0 to 10 0 0	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	9 15 0 to 10 0 0	—
„ (Lancs. Boiler)	13 0 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	—
Intermediate Basic	9 0 0	—
Soft Basic	8 0 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
Midlands—		
Small Rolled Bars	9 5 0 to 10 0 0	
Billets and Sheet-bars	7 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 17 6 to 18 0 0	
Angles	9 5 0	—
Joists	9 5 0	—
Tees	10 5 0	—
Bridge and Tank Plates	9 15 0 to 10 0 0	
Boiler Plates	13 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	22/6
Block Tin (cash)	£50 10 0
„ (three months)	£52 5 0
Copper (cash)	£3 15 0
„ (three months)	£3 15 0
Spanish Lead (cash)	£6 17 6
„ (three months)	£4 18 9
Spelter (cash)	£3 13 9
„ (three months)	£3 10 0
Manchester—	
Copper, Best Selected Ingots	£7 10 0
„ Electrolytic	£8 10 0
„ Strong Sheets	£2 0 0
„ Tubes (Basis price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
„ Condenser	0 1 2
Lead, English	£9 0 0
„ Foreign	£7 15 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
„ 6 p.c. to 8 p.c. „	£23 10 0	7/9
„ 8 p.c. to 10 p.c. „	£23 0 0	7/6
„ Specially Refined		
„ Max. 2 p.c. carbon	£13 0 0	16/-
„ „ 1 p.c. „	£52 0 0	17/6
„ „ 0.75 p.c. carbon	£60 0 0	20/-
„ „ carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
„ „ 75 p.c.	£17 17 6 scale 6/- per unit	
„ Vanadium	18/3 per lb.	
„ Molybdenum	7/9 per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£155	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	17/3
„ „ Ell	19/-
„ „ Splint	21/- to 23/3
„ „ Trebles	21/-
„ „ Doubles	18/0
„ „ Singles	13/6
Ayrshire—	
(f.o.b. Ports)—Steam	17/3
„ „ Splint	21/-
„ „ Trebles	21/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	15/6 to 17/3
Screened Navigation	25/6
Trebles	24/-
Doubles	19/-
Singles	14/-
Lothians—	
(f.o.b. Leith)—Best Steam	17/-
Secondary Steam	16/-
Trebles	21/9
Doubles	19/3
Singles	14/3

ENGLAND.

(8) N.W. Coast—	
Steams	28/6
Household	45/- to 58/4
Coke	32/6
Northumberland—	
Best Steams	17/9 to 18/-
Second Steams	17/6 to 18/-
Steam Smalls	10/6 to 11/-
Unscreened	15/6 to 17/-
Household	23/6 to 25/-
Durham—	
Best Gas	21/- to 21/6
Second	17/6 to 18/3
Household	23/6 to 25/-
Foundry Coke	25/6
Sheffield—	Inland.
Best Hand-picked Branch	32/- to 35/- —
Barnsley Best Silkstone	26/- to 28/- —
Derbyshire Best Brights	27/- to 32/- —
„ „ House	24/- to 26/- —
„ „ Large Nuts	22/6 to 25/- —
„ „ Small „	14/- to 16/- —
Yorkshire Hards	21/6 to 23/6 —
Derbyshire „	21/- to 23/- —
Rough Slacks	11/- to 13/6 —
Nutty „	10/- to 12/- —
Smalls	6/- to 8/6 —
Blast-furnace Coke (Inland)*	— —
„ „ (Export)	f.o.b. 25/- to 25/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	27/- to 27/6
Second „ „	25/- to 26/-
Best Dry Large	27/6 to 28/-
Ordinary Dry Large	24/- to 26/-
Best Black Vein Large	24/- to 25/-
Western Valley „	23/6 to 24/-
Best Eastern Valley Large	23/- to 24/-
Ordinary „ „	22/6 to 23/-
Best Steam Smalls	18/- to 18/-
Ordinary „	13/- to 15/-
Washed Nuts	25/- to 31/-
No. 3 Rhondda Large	27/- to 27/6
„ „ Smalls	19/- to 20/-
No. 2 „ Large	22/6 to 24/-
„ „ Through	18/- to 20/-
„ „ Smalls	10/- to 12/-
Foundry Coke (export)	45/- to 52/6
Furnace Coke (export)	30/- to 35/-
Patent Fuel	25/6 to 28/-
Pitwood (ex ship)	26/- to 27/-
Swansea—	
Anthracite Coals	
Best Big Vein Large	47/6 to 52/6
Seconds	45/- to 47/6
Red Vein	32/6 to 35/-
Machine-made Cobbles	60/- to 62/6
Nuts	55/- to 62/6
Beans	40/- to 45/-
Peas	20/- to 23/-
Breaker Duff	10/- to 10/6
Rubbly Culm	12/3 to 12/9
Steam Coals:	
Large	22/6 to 23/6
Seconds	22/- to 22/6
Smalls	14/- to 16/-
Cargo Through	17/- to 19/-

(1) Delivered (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated.

coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast furnaces only, 16/8, with fluctuations

according to analysis: open market, round about 22/6 to 25/- at ovens. † Latest quotations available. (a) Delivered Sheffield or Glasgow. Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Future.

The future of the metallurgical industries is turning upon the negotiations now being carried out with Germany for a treaty of commerce. So great are the changes that have taken place in the iron and steel trades here that Germany has become quite an important factor in their development, first, in providing an outlet for the manufactured products of the restored provinces, and, secondly, in supplying this country with coal and coke and certain other raw materials. Should Germany place barriers against the importation of goods from Alsace and Lorraine, the situation of manufacturers in those provinces would become precarious, and they would have no alternative but to compete in the home market, which French makers elsewhere are particularly anxious to avoid. On the other hand, the Germans will not offer facilities for trade to the Rhine provinces, and will certainly not favour the French iron trade by supplying more coal and coke than they are obliged to do, unless they are given special opportunities for trading with France. Statements have been made during the week implying that the Germans insist on receiving the most-favoured-nation treatment, and that the French Government is disposed to accord that treatment so far as concerns certain branches of industry, such as electrical engineering and light engineering products, as well as machine tools, agricultural machinery and the like. French manufacturers, of course, raise strong objections against the granting of concessions of this kind, which they claim would be ruinous to the home industries, but it is clear that, so long as France is dependent upon Germany, she will have to pay for the advantages and conveniences offered. This creates a situation for French manufacturers which is causing them to look closely at the future. So far, they have been favoured to a certain extent by the monetary depreciation, which has enabled them to develop their foreign trade enormously; but, on the other hand, the fall in money values has reduced the country's purchasing power, which will be further accentuated by the forthcoming State loans and by the increasingly heavy burdens that are to be imposed upon the community. The only way of doing business, therefore, is to bring down manufacturing costs and sell more cheaply, and that has resulted in the development of mass production on a very large scale, with the consequence that in many industries one or two firms dominate all the others. The restricted purchasing power has created a vogue everywhere for economy and lower selling prices. The future depends upon cheaper methods of manufacture.

Roadmaking.

The many experiments being carried out with road-making materials seem to strengthen the preference being shown for concrete roads, but the engineers of the Ponts et Chaussées have not yet displayed any inclination to adopt definitely some of the systems that have given satisfactory results in tests, probably in the hope that the numerous experiments may reveal some new method of construction even more suitable. It is claimed that this has happened in the neighbourhood of Besançon, where Monsieur Quelle, engineer of the Ponts et Chaussées, has adopted a method which differs entirely from the ordinary principles of road-making in the sense that he employs soft calcareous materials, and builds a resilient road with a very hard surface. The materials are mixed with silicate of soda, and while the lower part remains unaffected by the atmosphere, and consequently forms a resilient bed, the silicate of soda at the surface, which has thoroughly permeated the soft material, is acted upon by the carbonic acid of the air, and forms a hard layer of silicate of lime. As this upper layer wears away, fresh silicate of soda is exposed to the air and hardens in turn, and the process of hardening continues automatically with the wear. About 20 kiloms. of silicated road have been under observation near Montbéliard, and, notwithstanding the particularly destructive atmospheric conditions with heavy snows and severe frosts in winter, there is said to be no trace of uneven wear. The silicated road costs nearly double as much as one of macadam construction, but it is said to last four times as long, so that there is a considerable economy in the long run.

Suburban Metropolitan.

A further report has just been presented upon the proposal to extend the Paris Metropolitan Railway to the suburbs. The original idea of the Municipal Council was to purchase from the Est Railway Company the line from the Bastille to Vernouil-l'Etang, and it has now been decided to take into consideration the acquisition from the Orleans Company of the line from the Luxemburg to Sceaux-Robinson and eventually to Massy-Palaiseau.

Foreign Trade.

The returns of foreign trade during the first nine months of the year continue to show a steady expansion of exports, which exceed the value of imports by 1246 million francs, the imports being estimated at 29,201 million francs, and the exports 30,447 million francs. The increases, as compared with the corresponding period of 1923, were 6680 million francs and 8916 million francs respectively. The improvement was particularly noticeable in the exports of manufactured goods, which were valued at 18,456 million francs, or five times as much as the value of manufactured goods imported. In the tonnage there is a reversal of these comparative figures, for while the imports totalled 42,740,515 tons, the exports amounted to only 21,241,782 tons, but in the former total coal and other raw material accounted for 37,395,367 tons, and in the export figures manufactured goods amounted to 2,710,785 tons, an increase of 561,252 tons on the year. The imports of manufactured goods, amounting to 1,073,616 tons, showed a small diminution upon the total for the first nine months of 1923.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

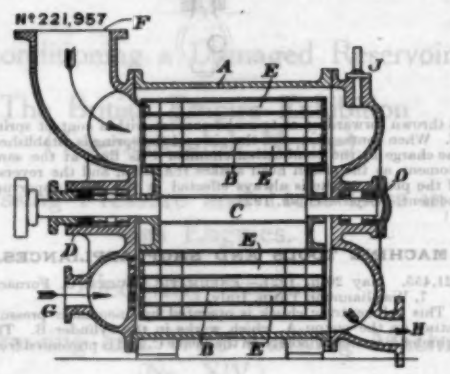
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

CONDENSERS AND FEED-WATER HEATERS.

221,057. September 21st, 1923.—Condensers, F. Ries, Kaiserstrasse 45, München, Germany.

This condenser consists of a stationary casing A and a rotor B mounted upon a shaft C which revolves in bearings in the casing. The rotor B, which makes about 200 revolutions per minute, is formed of a series of thin walled telescoped sheet metal cylinders E, both ends of which are slightly inturned. The cooling water entering at G at one end of the sheet metal cylinders, is distributed by centrifugal force into thin sheets of fluid and is flung out at the other end, where the sheet metal cylinders are turned

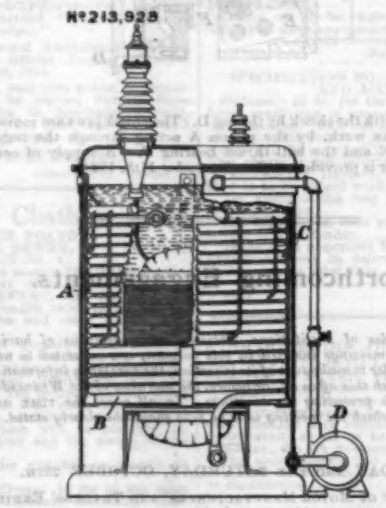


inward to a less extent in the form of a thin sheet. The steam entering through the inlet F has to pass over the water surface upon the inner side of the sheet metal cylinders, and by doing so is condensed. The steam also contacts with the exterior surface of the sheet metal cylinders so that heat transference takes place through these to the water on the inner surface of the cylinders. Any portions of steam remaining uncondensed at the end of the cylinder are there completely condensed in the ejected sheet of water. The condensate is led off through the outlet H while the air is drawn off through the pipe J in the usual fashion.—*September 25th*, 1924.

TRANSFORMERS AND CONVERTERS.

213,929. April 5th, 1924.—Improvements in and relating to Electric Transformers, *The British Thomson-Houston Company, Limited, of Crown House, Aldwych, W.C.* 2.

The transformer described in this specification is immersed in oil, as shown, and cooling water is passed through the pipes A. A cylinder B, preferably made of insulating material, serves to separate the cool oil about the coiled pipes from the warm oil near the transformer. The oil ascends inside the cylinder B,

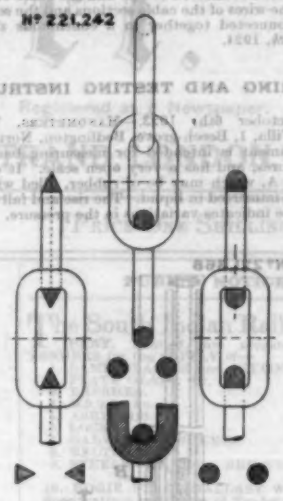


where it absorbs heat from the transformer, and descends outside the cylinder, where heat is given up to the pipes A. Means are provided for increasing the efficiency of these pipes. Small pipes C are supplied with cooling and insulating oil under pressure from a suitable source by means of a pressure pump D. The oil in the pipes C is forced through small openings in the lower ends in the form of jets, thus increasing the rate at which the oil is brought into contact with the water-cooled pipes.—*September 11th*, 1924.

TELEGRAPHS AND TELEPHONES.

221,242. May 3rd, 1923.—Improvements in Insulators, William Joseph Polyblank, of Air Ministry, Adastral House, Kingsway, W.C. 2.

According to this invention, insulators as used for wireless aerials or high-voltage conductors are composed of a series of links or members of insulating material. The links of the chains are made of glazed porcelain, ebonite or other insulating material. Several alternative constructions are illustrated. The links present a point, a knife-edge or a line contact, where the adjacent links engage with one another. The end links of the chain constitute the terminals of the insulator, and may be joined with



screw-threaded stems of metal. The links may be made of round, oval, triangular material, and may be constructed in several forms.—*September 3rd*, 1924.

TRANSMISSION OF POWER.

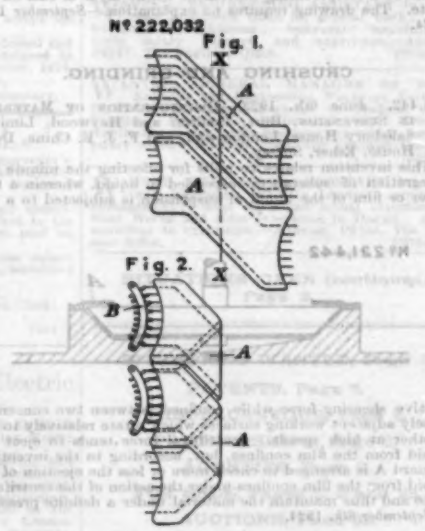
221,371. October 9th, 1923.—Improvements in Multi-core Electric Cables, W. T. Henley's Telegraph Works Company, of 13 and 14, Bloomfield-street, London-wall, and Percy Dunsheath, of W. T. Henley's Telegraph Works Company, Limited, Gravesend.

One form of cable constructed in accordance with this invention is illustrated. Three conductors A, covered with insulating

material B and sheathed with lead C, are laid up and enclosed together with suitable filling material D within a steel tape-armouring E, laid over a bedding F and with an outer covering G, whilst longitudinally extending lengths of stranded steel or other reinforcing wires H are laid up between adjacent pairs of covered cores A and embedded in the surrounding filling material D.—*September 11th*, 1924.

222,032. February 22nd, 1924.—Flat Electric Cables, *The International Electric Company, Ashley-road, Tottenham, London.*

This invention relates to flat electric cables having branch connections from the side. For instance, the relatively short sections A can be easily and quickly manufactured by hand by winding a wire round suitably secured pins. A strip of paper or



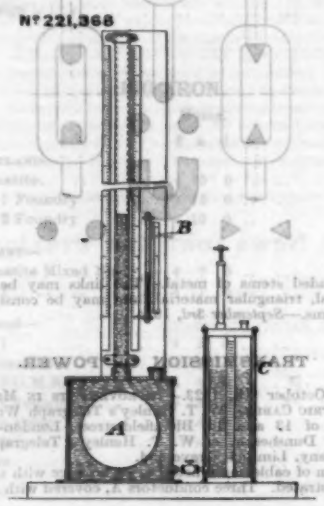
other insulating material cut to the required shape is placed under the wound wire, and a similar strip is placed on the top and glued on. The section is then placed aside to dry and then cut at the edge, the wire which was up to that time a continuous one being thus divided into the number of conductors shown. The cable sections are then folded, as shown in Fig. 2, along the central line X—X indicated in and superposed for

the purpose of soldering on to the contact sets B in such manner that during the soldering the beginning and end respectively of adjoining cable sections overlap each other. During the soldering one wire of one cable section and one wire of the adjoining cable sections are connected to one and the same contact blade. In this way the wires of the cable sections and the sets of contact blades are connected together in a continuous zigzag line.—*September 25th*, 1924.

MEASURING AND TESTING INSTRUMENTS.

221,368. October 6th, 1923.—Manometers, W. Temple, Westoe Villa, 1, Beech-grove, Bedlington, Northumberland.

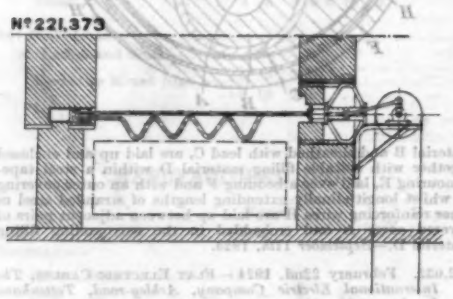
This instrument is intended for measuring barometric and similar pressures, and has a very open scale. It comprises an elastic vessel A, which may be of rubber, filled with air under pressure, and immersed in liquid. The rise and fall of this liquid in a glass tube indicates variations in the pressure. In the illustration B is a thermometer, and C a vessel which can be put under pressure to compensate for variations in temperature. The inventor says that with an elastic vessel 3in. in diameter, filled at a pressure of 20 lb. per square inch and placed in another vessel having a capacity equal to a sphere of 10in. diameter, a rise or fall of water in a tube 1in. diameter, of 18in. will represent a barometric change of 9in. of mercury.—*September 11th*, 1924.



FURNACES.

221,373. October 16th, 1923.—Mechanical Stokers, *J. Y. Johnson*, 47, *Lincoln's Inn-fields, London.*

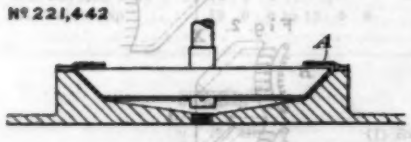
According to this invention, an automatic stoking device is provided which is caused to effect a reciprocating or oscillating movement within the layer of fuel on the grate. The stoking device consists of a curved pipe, through which water can be caused to flow for cooling the same, and which preferably has a zigzag or saw-like shape, and which by suitable means is caused to make a reciprocating movement in the layer of fuel on the grate. The drawing requires no explanation.—*September 11th*, 1924.



CRUSHING AND GRINDING.

221,442. June 6th, 1923.—Disintegration of Materials in Suspension, Burt, Boulton and Haywood, Limited, Salisbury House, London-wall, and F. J. E. China, Down House, Esher, Surrey.

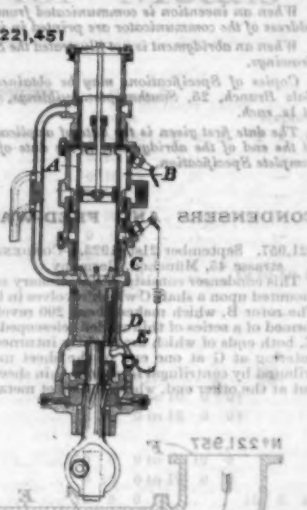
This invention relates to mills for effecting the minute disintegration of substances suspended in liquid, wherein a thin layer or film of the liquid or suspension is subjected to a disruptive shearing force while confined between two concentric closely adjacent working surfaces which rotate relatively to one another at high speeds. Centrifugal force tends to eject the liquid from the film confines, but, according to the invention, a guard A is arranged to check more or less the ejection of the liquid from the film confines under the action of the centrifugal force and thus maintain the material under a definite pressure.—*September 8th*, 1924.



MINING MACHINERY.

221,451. June 5th, 1923.—An Internal Combustion Rock Drill, J. V. Rice, jun., Bank-street, Bordentown, New Jersey.

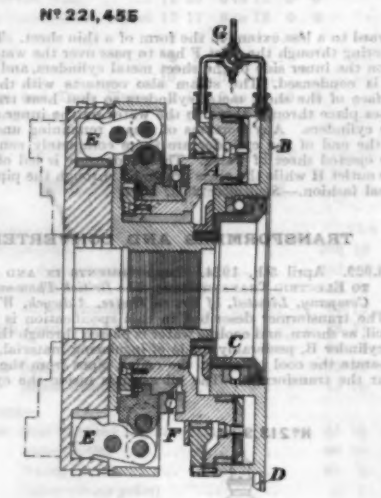
In this rock drill the hollow cylindrical differential piston A is propelled in opposite directions by explosions, alternately effected in the combustion chambers B and C respectively. In its forward stroke, caused by the explosions in the chamber B, the piston head strikes the anvil of the tool holder. A weighted pin D is held by means of a light spring in a recess in the piston head. Upon impact of the piston head with the anvil, the pin is thrown forward so as to make contact with a contact spring E. When contact between the pin and the spring is established, the charge in the combustion chamber C is fired at the same moment, as the piston head strikes the anvil, and the reversal of the piston stroke is always effected at the most opportune moment.—*September 5th*, 1924.



MACHINE TOOLS AND SHOP APPLIANCES.

221,455. May 20th, 1924.—Pneumatic Chucks, G. Fornaca, 7, Via Giannoni, Turin, Italy.

This self-centring chuck is operated by pneumatic pressure acting on the piston A, which works in the cylinder B. The cylinder is mounted loosely on the sleeve C, and is prevented from rotating with the chuck by the lug D. The chuck jaws are moved to grip the work, by the piston A acting through the toggle levers E E and the ball thrust bearing F. A supply of compressed air is provided at G.—*September 11th*, 1924.



Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY AND TILL SATURDAY, OCTOBER 25TH.

Society of Motor Manufacturers' and Traders' Exhibition at Olympia. 10 a.m. each day.

TO-DAY.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Powdered Fuel," by Mr. F. F. Evans. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's Gate, London, S.W. 1. "The Missing Pressure in Gas Engines; and Heat Loss in Gas Engines," by Professor W. T. David. 6 p.m.

Manchester Association of Engineers.—Engineers' Club, Manchester. Paper, "Costing and Works Accounting, with special reference to Engineering," by Mr. R. Dunkerley. 7.15 p.m.

Physical Society of London.—Imperial College of Science, South Kensington, London, S.W. 7. Papers: "Underblown Pipes," by Messrs. D. Gunnaiya and G. Subrahmaniam, with demonstration by Mr. D. J. Blaikley; "On the Temperature Gradient in Gases at Various Pressures," by Messrs. W. Mandell and J. West; "Vectorial Dimensions," by Mr. J. F. S. Ross. 5 p.m.

SATURDAY, OCTOBER 25TH.

Institution of Automobile Engineers.—London graduates' visit to the Croydon Aerodrome, Waddon. 2.30 p.m.

Institution of Municipal and County Engineers.—Southern District meeting at Windsor. 11 a.m.

MONDAY, OCTOBER 27TH.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. Presidential address, "Research," by Dr. W. R. Ormandy. 7.30 p.m.

TUESDAY, OCTOBER 28TH.

Institution of Automobile Engineers.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Informal meeting at which recent inventions in connection with motor cars will be demonstrated and discussed. 7 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, London, S.W. 1. Extra Meeting. "The Economic Position of Great Britain," by Mr. Edgar Crammond. 6 p.m.

Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Discussion on paper, "Pulverised Fuel in its Commercial Aspect," by Mr. A. J. T. Taylor. Paper, "A Proposed Form of Bow Construction," by Mr. E. F. Spanner. 7.30 p.m.

WEDNESDAY, OCTOBER 29TH.

Institute of Physics.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Lecture, "Physics in Industry," No. 7, "Electrical Precipitation," by Sir Oliver Lodge. 5.30 p.m.

University of London.—University College, Gower-street, London, W.C. 1. Lecture, "High Frequency Electric Measurements," I. "High Frequency Resistance," by Professor J. A. Fleming. 5 p.m.

THURSDAY, OCTOBER 30TH.

Institution of Automobile Engineers: Birmingham Centre.—Chamber of Commerce, New-street, Birmingham. Presidential address, "Research," by Dr. W. R. Ormandy. 6.45 p.m.

Institution of Locomotive Engineers.—The Engineers' Club, Coventry-street, London, W.1. Presidential address by Mr. J. E. Anderson. Lecture, "Solid Crank Axles for Locomotives," by Sir Henry Fowler. 7 p.m.

Royal Aeronautical Society.—7, Albemarle-street, London, W. 1. Paper, "The R. Ae. C. Light Aeroplane Competitions," by Major J. S. Buchanan. 5.30 p.m.

University of Sheffield: Department of Fuel Technology.—Mappin Hall of the Applied Science Department, St. George's-square, Sheffield. Lecture, "Furnace Heating, I.," by Mr. R. J. Sarjant. 5.15 p.m.

FRIDAY, OCTOBER 31ST.

Institute of Marine Engineers.—Hotel Cecil, Strand, London, W.C. 2. Annual Dinner. 6.30 p.m.

Institution of Mechanical Engineers.—Storey's Gate, London, S.W. 1. Informal meeting. Discussion on "Engineering Novelties at the British Empire Exhibition." 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Audio-frequency Transformers," by Mr. H. J. N. Riddle. 7.30 p.m.

MONDAY, NOVEMBER 3RD.

Royal Institute of British Architects.—9, Conduit-street, Regent-street, London, W. 1. President's address. 8.30 p.m.

TUESDAY, NOVEMBER 4TH.

Institution of Electrical Engineers: North-Western Centre.—Midland Hotel, Manchester. Chairman's address. 7 p.m.

Manchester Metallurgical Society.—College of Technology, Manchester. Paper, "Properties of Metals at High Temperatures," by Professor F. C. Thompson. 7 p.m.

TUESDAY TO THURSDAY, NOVEMBER 4TH TO 6TH.

Smoke Abatement League of Great Britain.—Town Hall, Manchester. Conference on Smoke Abatement.

TUESDAY TO SATURDAY, NOVEMBER 4TH TO 15TH.

Smoke Abatement Exhibition at the City Exhibition Hall, Deansgate, Manchester.

WEDNESDAY, NOVEMBER 5TH.

Institution of Chemical Engineers.—University College, Gower-street, London, W.C. 1. Paper, "The Water Gas Process," by Dr. M. W. Travers. 8 p.m.

Institution of Sanitary Engineers.—Holborn Restaurant, London, W.C. 1. Annual dinner. 7.30 p.m.

University of London.—University College, Gower-street, London, W.C. 1. Lecture, "High-frequency Electric Measurements," II., "High-frequency Currents and Voltages," by Professor J. A. Fleming. 5 p.m.

THURSDAY, NOVEMBER 6TH.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Paper, "An Electric Harmonic Analyser," by Messrs. J. D. Cockroft, R. T. Coe, J. A. Tyacke, and Professor Miles Walker. 6 p.m.

Institution of Mechanical Engineers: North-Western Section.—Engineers' Club, Manchester. Paper, "Missing Pressure in Gas Engines," by Professor W. T. David. 7 p.m.

FRIDAY, NOVEMBER 7TH.

Institution of Mechanical Engineers.—Storey's Gate, London, S.W. 1. Thomas Hawksley Lecture, "The Trend of Development of Marine Propelling Machinery," by Vice-Admiral Sir George G. Goodwin. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "History and Construction of the Fire-engine," by Mr. H. C. Jones. 7.30 p.m.

WEDNESDAY, NOVEMBER 12TH.

Newcomen Society.—Room 1, Caxton Hall, Westminster, London, S.W. 1. Annual general meeting. Paper, "Some Original Models of Smeaton's Eddystone Lighthouse," by Mr. T. Rowatt. 5.30 p.m.

Women's Engineering Society.—Lady Parsons' House, 1, Upper Brook-street, London, W. 1. Meeting to discuss the formation of a Women's Electrical Association. 4.30 p.m.